CHAPTER

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HYDRAULIC POWER

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HYDRAULIC POWER

DOUGLAS AIRCRAFT CO.

DC-8 SIXTY SERIES

MAINTENANCE MANUAL

CHAPTER

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HYDRAULIC POWER

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HYDRAULIC POWER

1. Table of Contents Microfilm -- Instructions For Use

   A. This microfilm contains the Table of Contents (TOC), and maintenance manual information for all DC-8 60 Series aircraft customers except Air Canada whose TOC reflects a combined 50/60 Series Maintenance Manual. For information on a specific aircraft, refer to TOC for the owner or lessee of that aircraft.

   B. Each Table of Contents page has the Chapter, CODE, and Page number in the bottom outside corner of the page. The CODE number determines the customer; for example, CODE 1 is United Air Lines, CODE 2 Delta Air Lines and so on. The Table of Contents lists the Aircraft Identification page (if applicable), Alphabetical Index, and Chapter, Section, Subject matter with applicable aircraft CODE. Adjacent to the CODE, the aircraft effectivity is listed.

   C. Aircraft are identified on the Table of Contents either by Effectivity Code Number, Fleet Number, Registration Number, or Factory Serial Number. The Factory Serial Number is used only when the Fleet Number or Registration Number is not available.

   D. Table of Contents for all customers are listed immediately following these instructions. Where applicable, the Aircraft Identification page is inserted immediately following the TOC. This Aircraft Identification page contains the name of the customer or lessee, Manufacturing Series, Factory Serial Number, Effectivity Code or Fleet Number, and Registration Number. The Aircraft Identification page will have a customer CODE as described above.

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United Air Lines, Inc.	UAL	1
Eastern Air Lines, Inc.	EAL	2
Swiss Air Transport Company, Ltd. Scandinavian Airlines System	SWA/SAS	3
Delta Air Lines, Inc.	DLT	4
National Airlines, Inc.	NAL	5
Braniff Airways, Inc. (was PAG)	BNF	6
Air Canada (was TCA)	AC	7
Alitalia-Linee Aeree Italiane	ALI	8
KLM-Royal Dutch Airlines	KLM	9
Trans International Airlines	TIA	10
Trans Caribbean Airways, Inc.	TRC	11
Canadian Pacific Air Lines, Ltd.	CPA	12
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Universal Airlines, Inc.	UNI	16
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Airlift International, Inc. (includes LYD)	ALF	20
Overseas National Airways, Inc.	ONA	21
Seaboard World Airlines, Inc.	SEA	22
Venezolana Internacional de Aviacion, S.A. (a/c included in KLM Contents)	VIA	23
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SWISS AIR TRANSPORT COMPANY, LTD.

SCANDINAVIAN AIRLINES SYSTEM

Manufacturing Series	Factory Serial Number	SWA/SAS Effectivity Code	Registration Letters	Customer
DC-8-62	45905	55	SE-DBF	SAS
DC-8-62	45906	56	OY-KTD	SAS
DC-8-62	45822	57	LN-MOO	SAS
DC-8-62	45823	58	SE-DBE	SAS
DC-8-62	45921	59	SE-DBG	SAS
DC-8-62	45919	60	HB-IDE	SWA
DC-8-62	45920	61	HB-IDF	SWA
DC-8-62	45925	62	HB-IDG	SWA
DC-8-62F	45922	63	OY-KTE	SAS
DC-8-62F	45984	64	HB-IDH	SWA
DC-8-62	46077	65	HB-IDI	SWA
DC-8-62F	46078	66	HB-IDK	SWA
DC-8-62	46134	67	HB-IDL	SWA
DC-8-62	46102	68	LN-MOG	SAS
DC-8-62CF	46129	69	SE-DBI	SAS
DC-8-63	45923	70	LN-MOU	SAS

Manufacturing Series	Factory Serial Number	SWA/SAS Effectivity Code	Registration Letters	Customer
DC-8-63	45924	71	SE-DBH	SAS
DC-8-63	46041	72	OY-KTF	SAS
DC-8-63	46054	73	LN-MOY	SAS
DC-8-63	46136	74	SE-DBK	SAS
DC-8-63	46163	75	SE-DBL	SAS
DC-8-63PF	46074	76		SWA
DC-8-62	46131	77	LN-MOW	SAS
DC-8-62AF	46150	78	LN-MOC	SAS

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AIRPLANE IDENTIFICATION

DELTA AIR LINES, INC.

Manufacturing Series	Factory Serial Number	Fleet Number	Registration Number
DC-8-61	45907	861	N822E
DC-8-61	45914	862	N823E
DC-8-61	45915	863	N824E
DC-8-61	45944	864	N825E
DC-8-61	45979	865	N826E
DC-8-61	46014	866	N1300L
DC-8-61	46018	867	N1301L
DC-8-61	46029	868	N1302L
DC-8-61	46030	869	N1303L
DC-8-61	46048	870	N1304L
DC-8-61	46072	871	N1305L
DC-8-61	46055	872	N1306L
DC-8-61	46056	873	N1307L

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AIRPLANE IDENTIFICATION

AIR CANADA

Manufacturing Series	Factory Serial Number	Fleet Number	Registration Number	Manufacturing Series	Factory Serial Number	Fleet Number	Registration Number
DC-8-40	45442	801	CF-TJA	DC-8-50	45962	822	CF-TIJ
DC-8-40	45443	802	CF-TJB	DC-8-61	45890	860	CF-TJT
DC-8-40	45444	803	CF-TJC	DC-8-61	45891	861	CF-TJU
DC-8-40	45445	804	CF-TJD	DC-8-61	45892	862	CF-TJV
DC-8-40	45565	805	CF-TJE	DC-8-61	45893	863	CF-TJW
DC-8-40	45566	806	CF-TJF	DC-8-61	45963	864	CF-TJX
DC-8-40	45609	807	CF-TJG	DC-8-61	45964	865	CF-TJY
DC-8-40	45610	808	CF-TJH	DC-8-61	45980	866	CF-TJZ
DC-8-40	45611	809	CF-TJI	DC-8-63	46033	867	CF-TIK
DC-8-40	45612	810	CF-TJJ	DC-8-63	46034	868	CF-TIL
DC-8-40	45638	811	CF-TJK	DC-8-63	46035	869	CF-TIM
DC-8-50F	45640	812	CF-TJL	DC-8-63	46036	870	CF-TIN
DC-8-50F	45653	813	CF-TJM	DC-8-63	46076	871	CF-TIO
DC-8-50F	45654	814	CF-TJN	DC-8-63	46100	872	CF-TIP
DC-8-50F	45655	815	CF-TJO	DC-8-63	46123	873	CF-TIQ
DC-8-50F	45679	816	CF-TJP	DC-8-63	46124	874	CF-TIR
DC-8-50F	45686	817	CF-TJQ	DC-8-63	46125	875	CF-TIS
DC-8-50F	45860	818	CF-TJR	DC-8-63	46113	876	CF-TIT
DC-8-50F	45861	819	CF-TJS	DC-8-63	46126	877	CF-TIU
DC-8-50	45933	820	CF-TIH	DC-8-63	46114	878	CF-TIV
DC-8-50	45934	821	CF-TII	DC-8-63	46115	879	CF-TIW

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GENERAL - DESCRIPTION AND OPERATION

1. Description

A. The hydraulic power system is a closed-center system which is pressurized to approximately 3000 psi with Skydrol fire-resistant hydraulic fluid. Skydrol is damaging to rubber tires, floor covering, paint, etc., and should not be permitted to come into contact with these items.

B. The main hydraulic system reservoir and separate air chamber are pressurized by a regulator-aspirator which maintains the pressure range at 30 to 35 psi. The main hydraulic reservoir supplies fluid to both engine-driven hydraulic pumps and/or the electrically-driven auxiliary hydraulic pump. The pumps supply hydraulic pressure to the left and right hydraulic power manifolds for distribution to the subsystems.

C. The auxiliary hydraulic pump alternate reservoir, used as an alternate hydraulic fluid supply to the auxiliary pump only, is connected to the auxiliary pump supply selector valve. The selector valve is opened to the alternate supply when the hydraulic system selector control lever is placed in the general system/main gear downlock and flap position.

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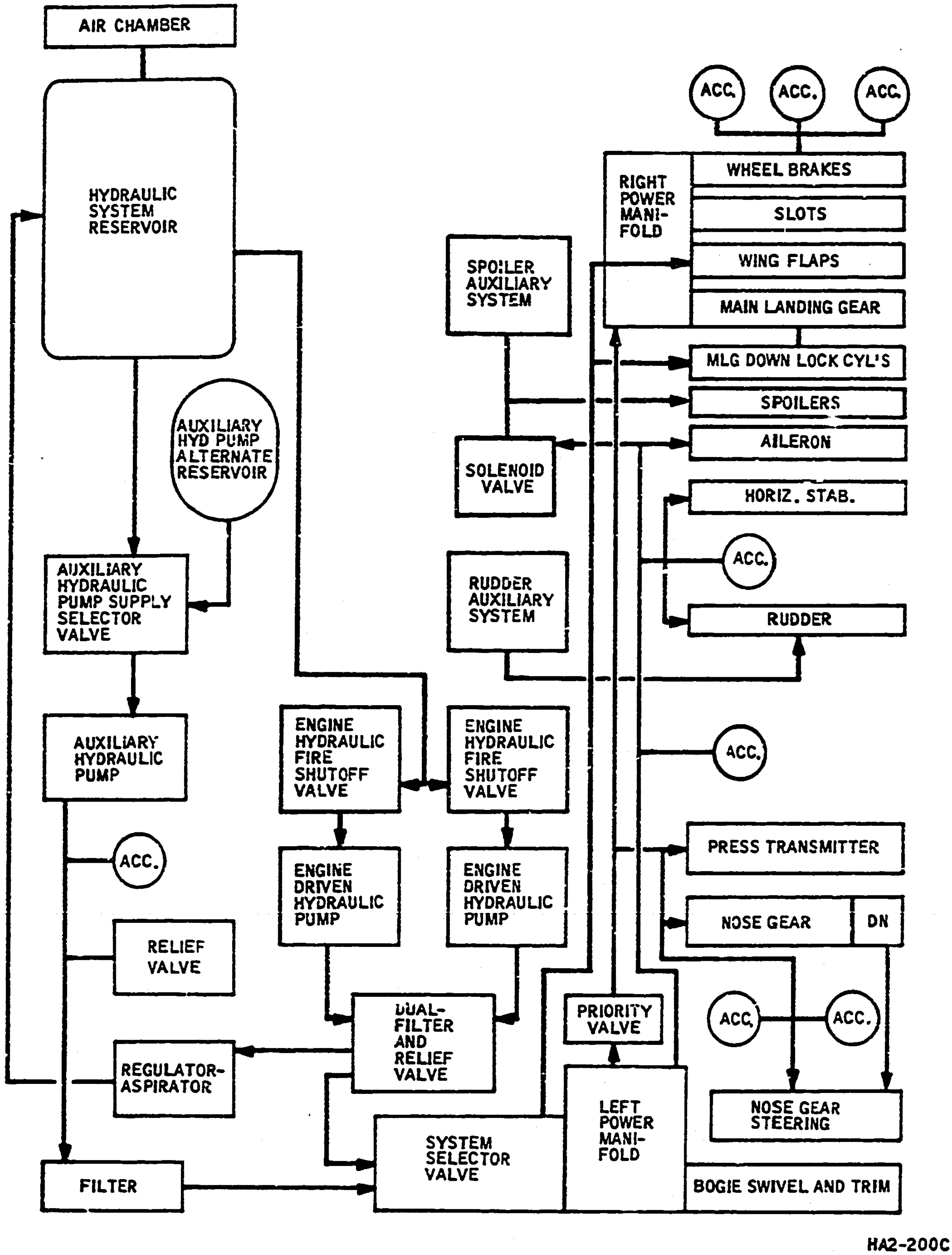

Hydraulic Power System -- Block Diagram
Figure 1

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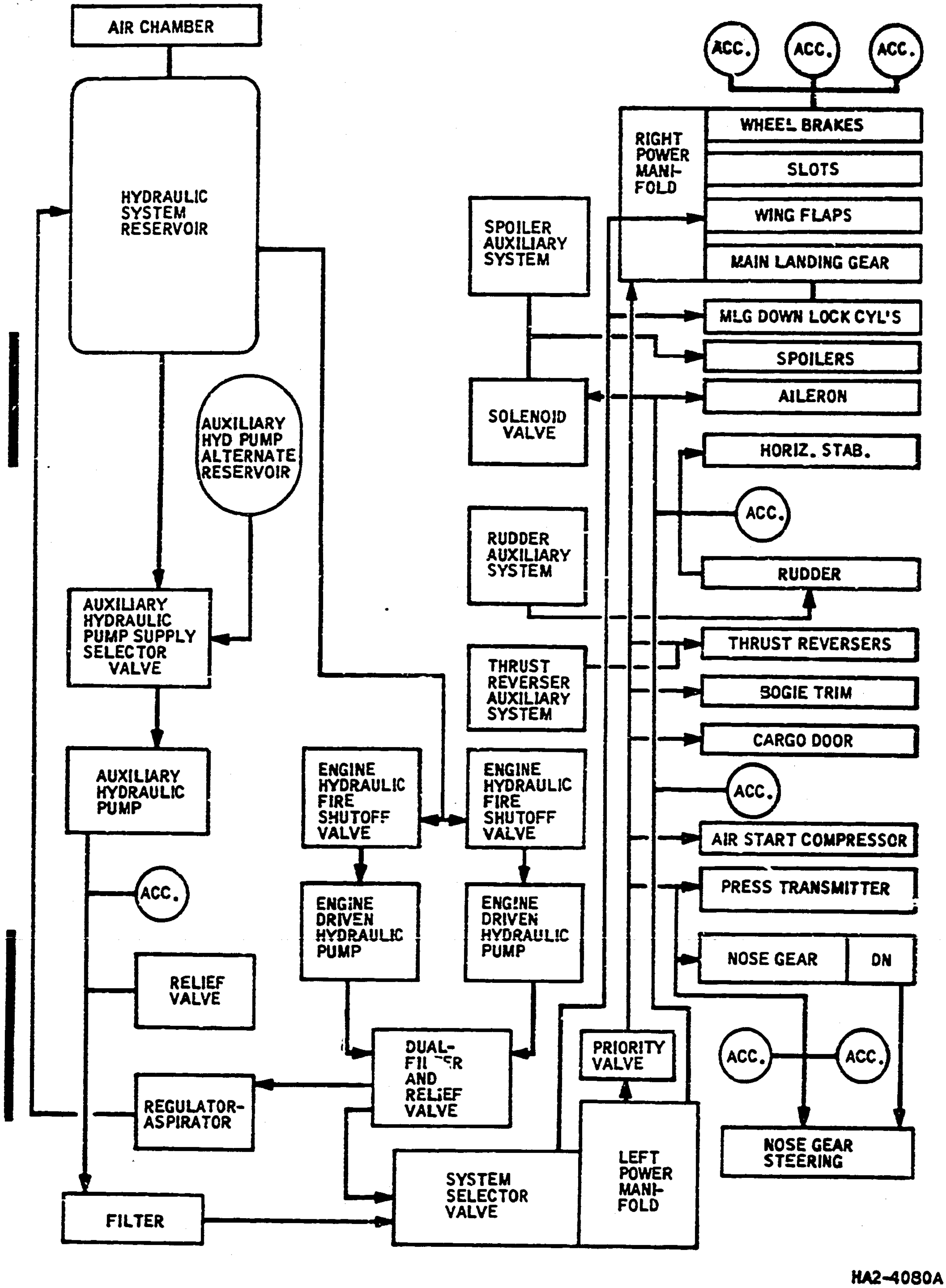

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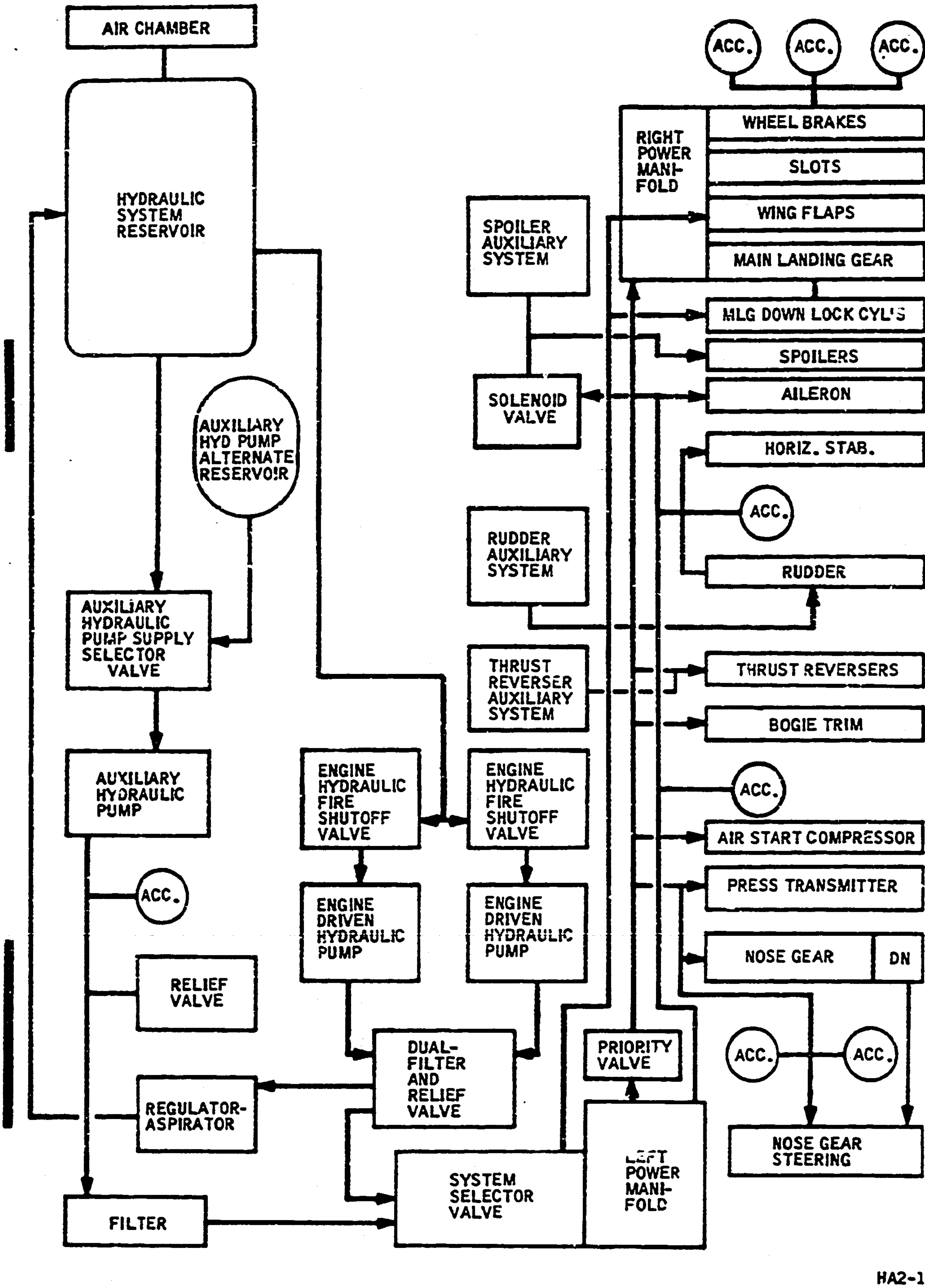

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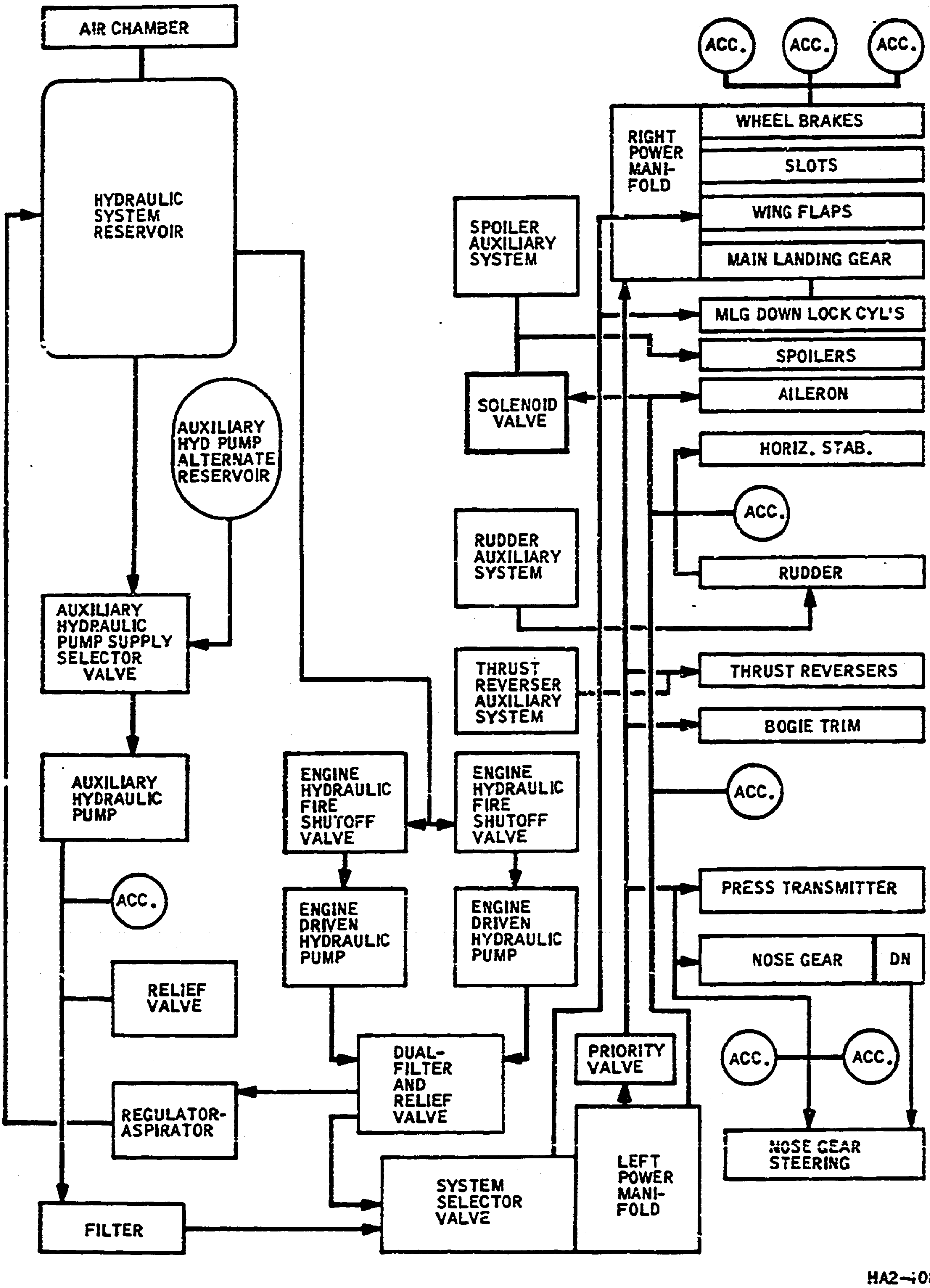

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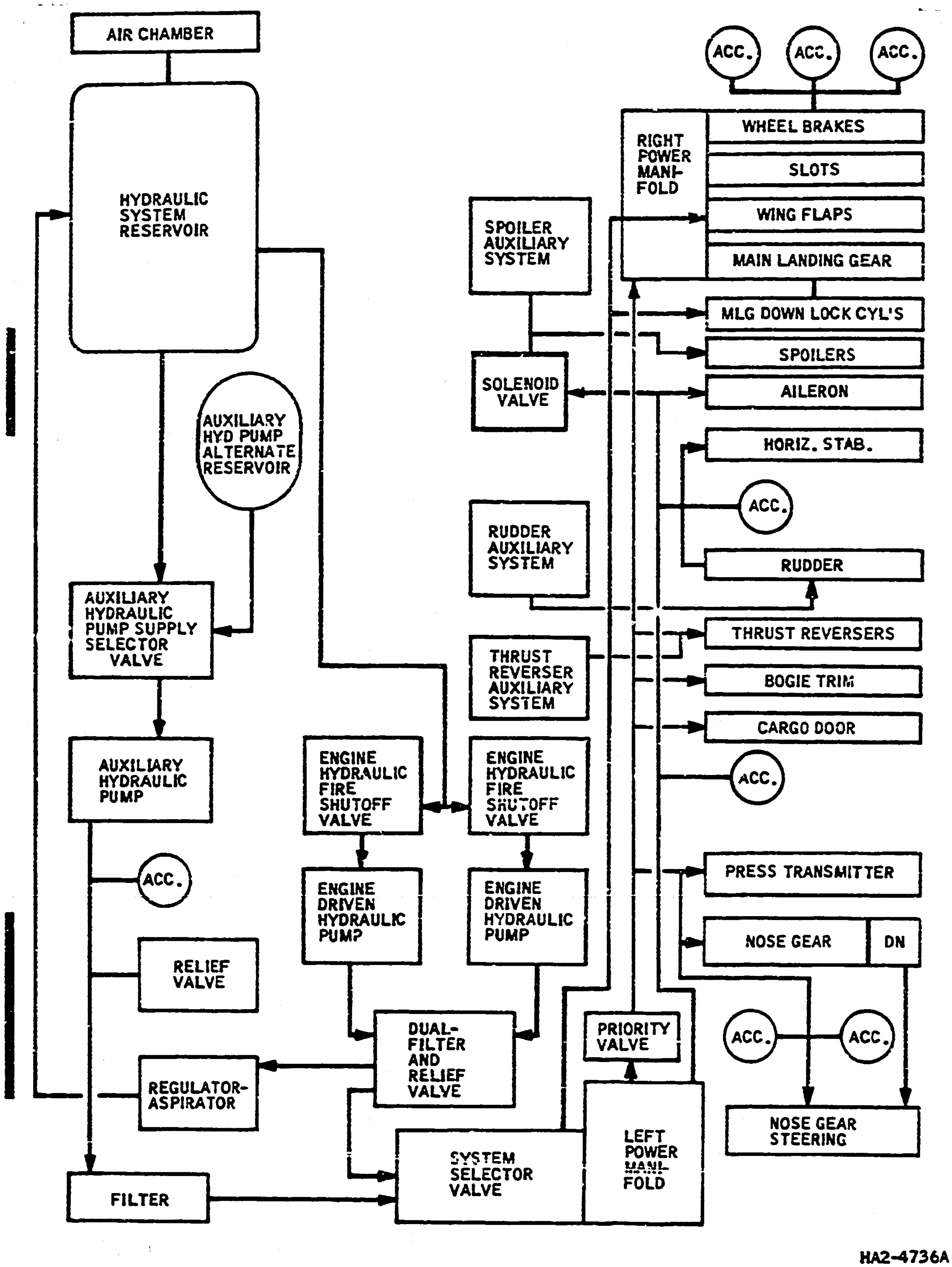

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B. The main hydraulic system reservoir and separate air chamber are pressurized by a regulator-aspirator which maintains the pressure range at 35 to 40 psi on airplanes 801 - 815 and 30 to 35 psi on airplanes 816 - 819, 860 and subsequent. The main hydraulic reservoir supplies fluid to both engine-driven hydraulic pumps and/or the electrically-driven auxiliary hydraulic pump. The pumps supply hydraulic pressure to the left and right hydraulic power manifolds for distribution to the subsystems.

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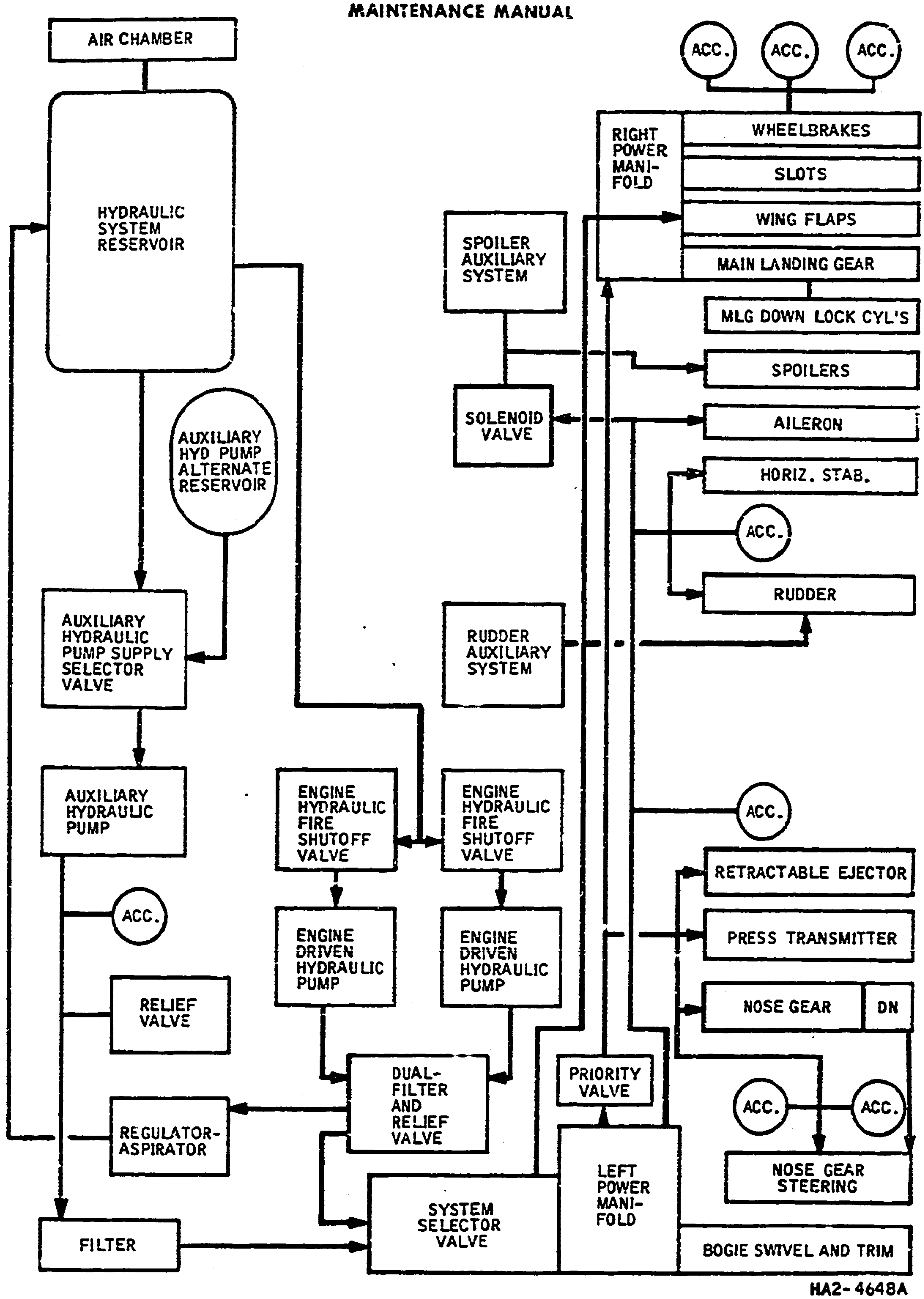
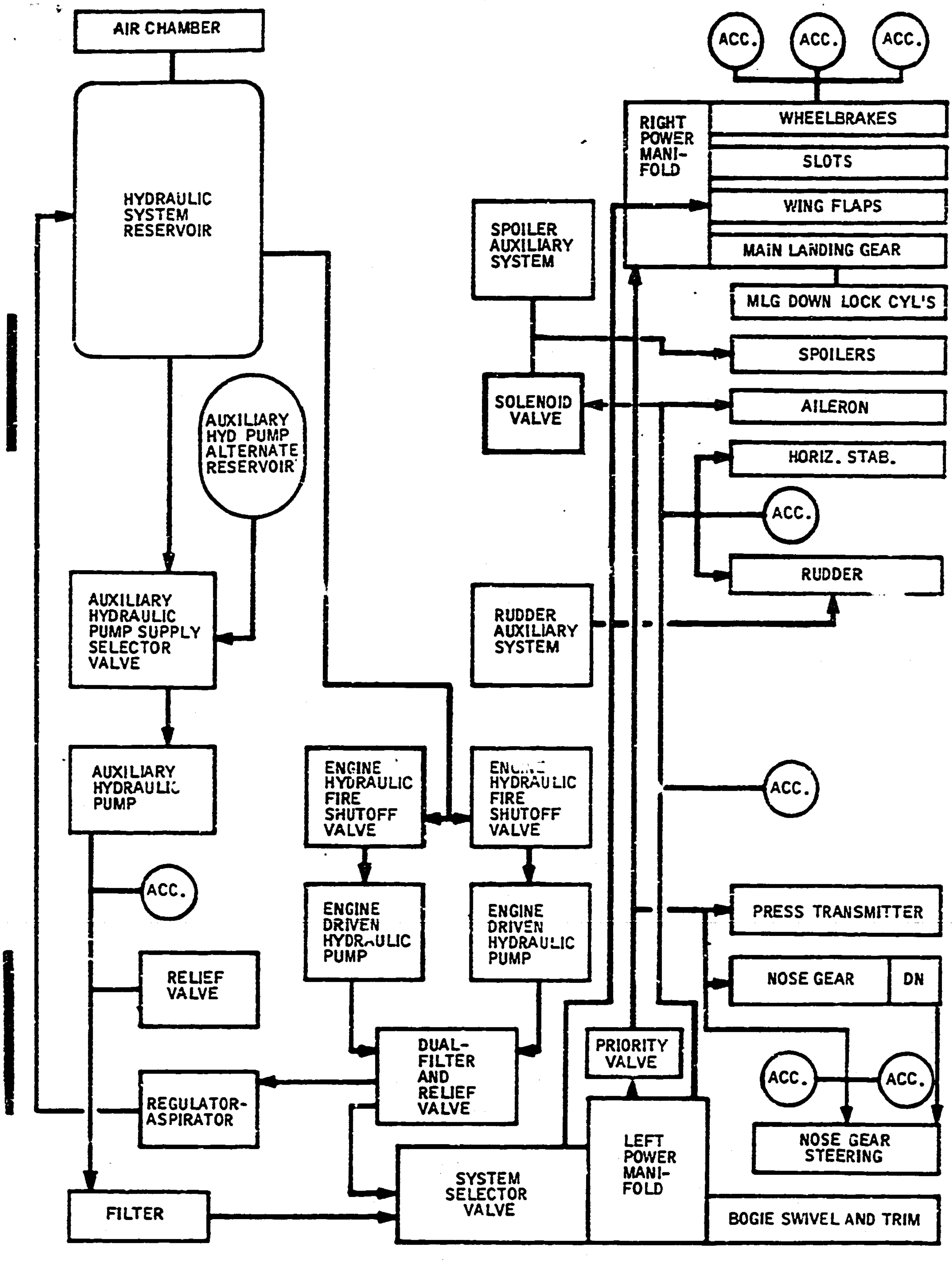
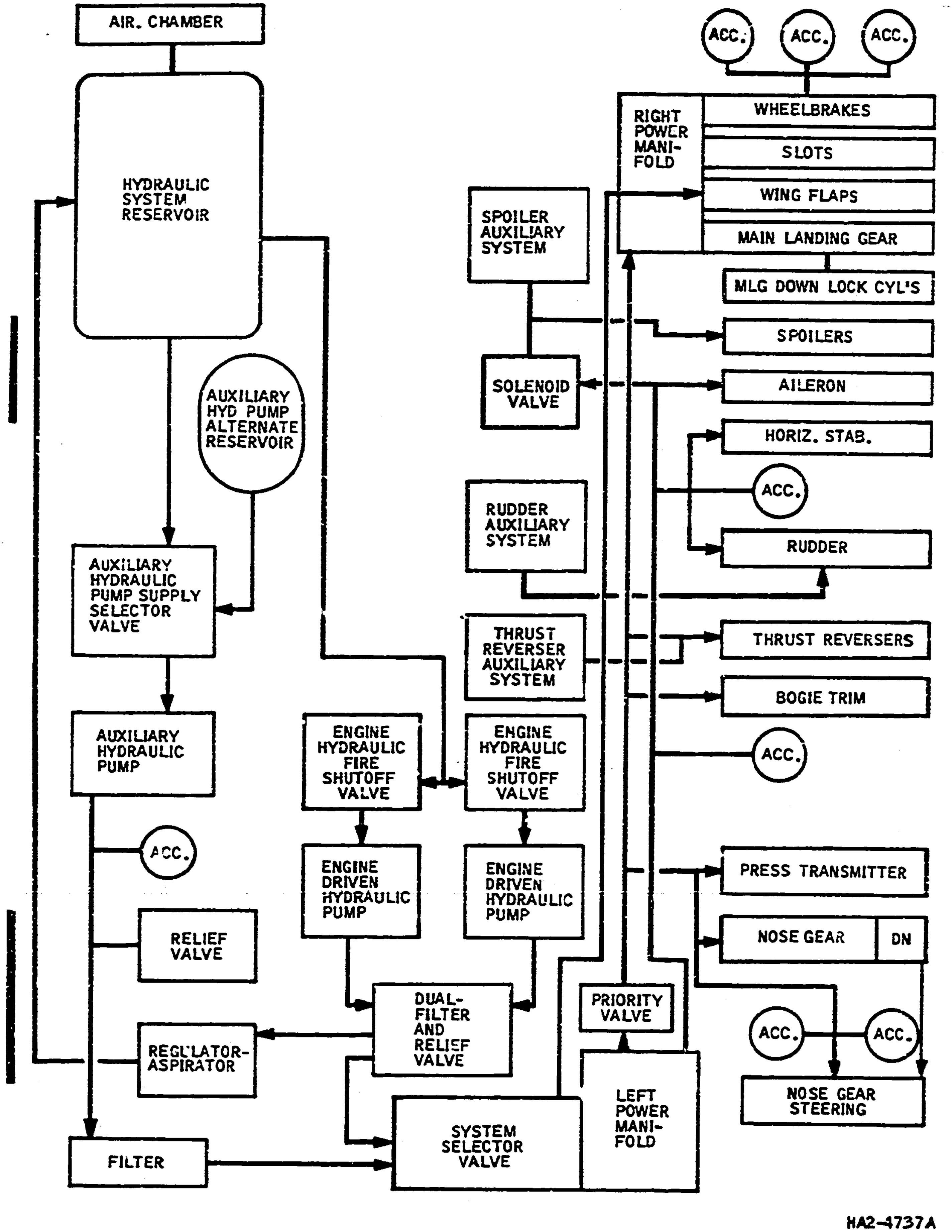


Hydraulic Power System -- Block Diagram
(Airplanes 801-811)
Figure 1 (Sheet 1)



Hydraulic Power System -- Block Diagram
(Airplanes 812 - 822, 860 - 866)
Figure 1 (Sheet 2)



Hydraulic Power System -- Block Diagram
(Airplane 867 and Subs)
Figure 1 (Sheet 3)

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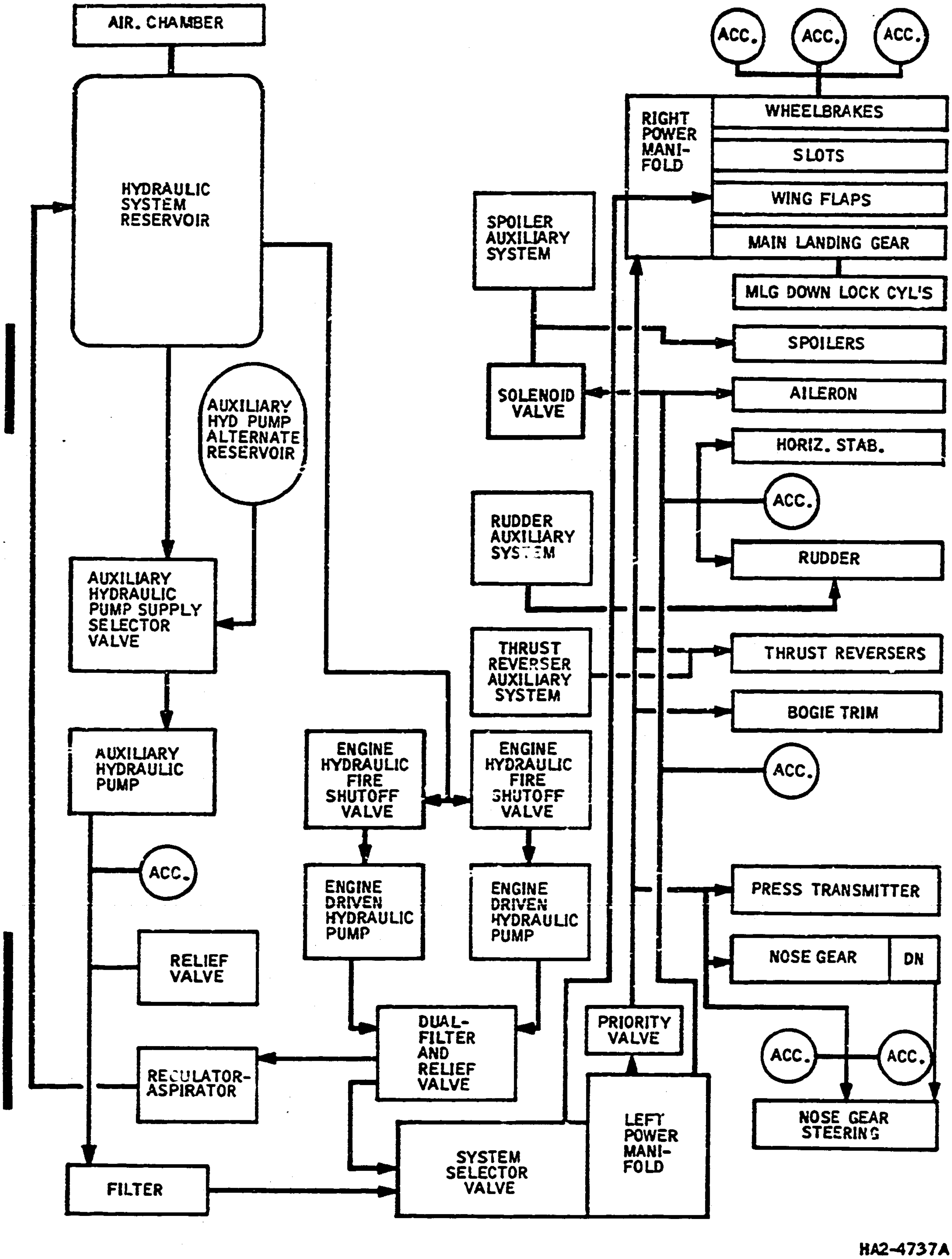

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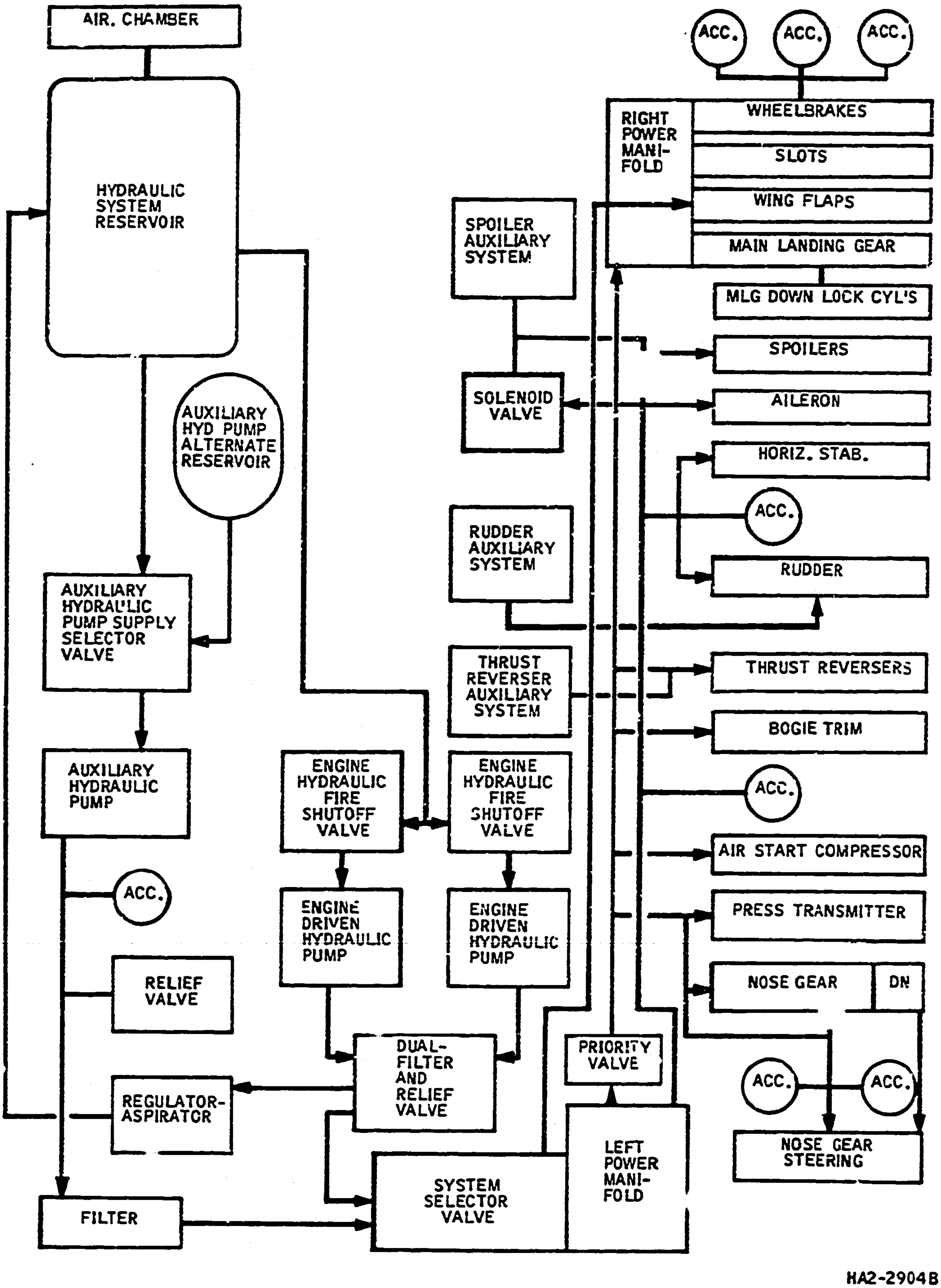

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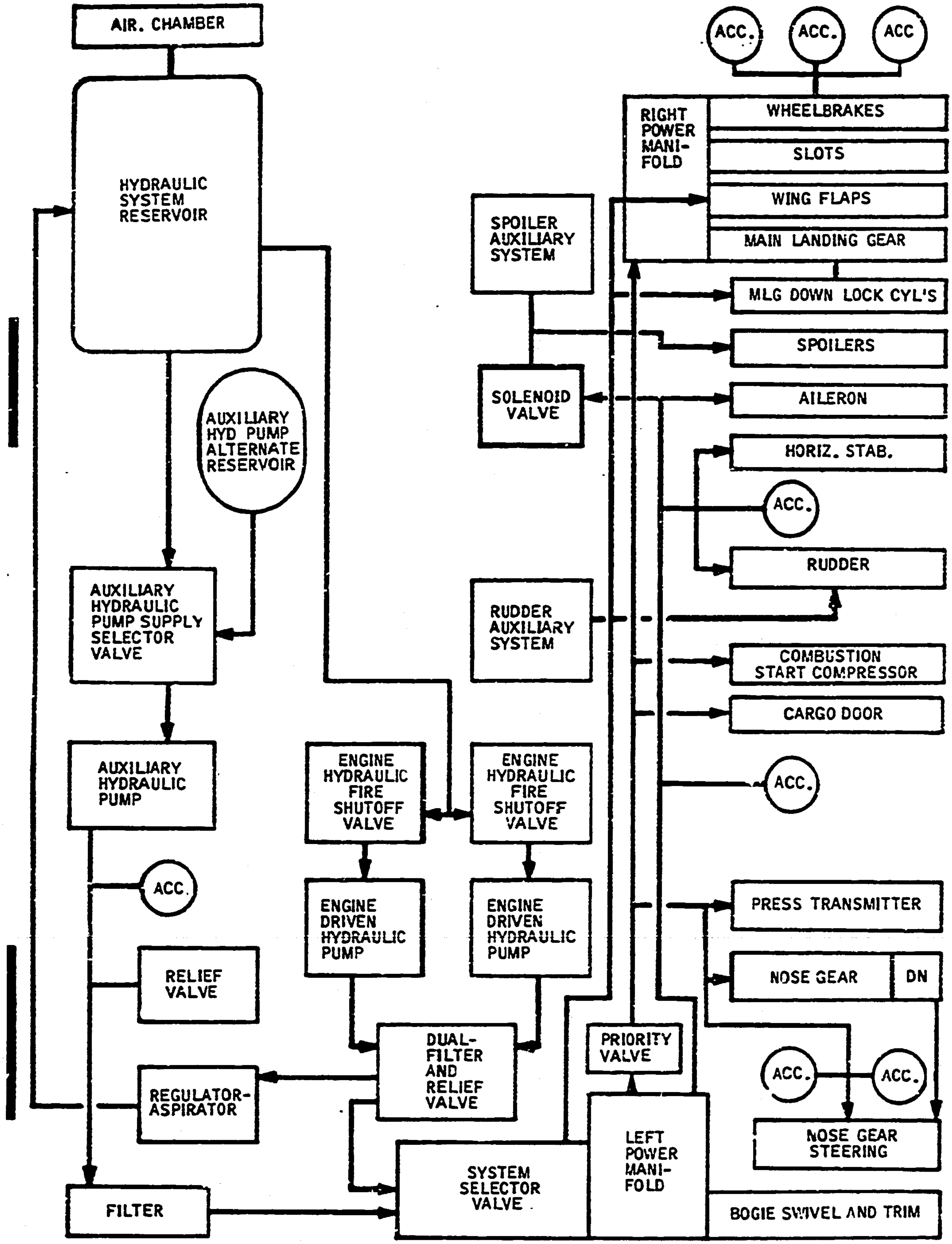


Hydraulic Power System -- Block Diagram
Figure 1

GENERAL - TROUBLESHOOTING

1. General

A. To successfully troubleshoot the hydraulic system, it is necessary to have a clear understanding of the operation of the system and of what takes place when the system is operating properly. After system operation is clearly understood, an orderly analysis of possible causes of improper operation can be made. The only things that can be wrong with the system are: insufficient fluid, air in the system, leaks, and clogged lines or fittings.

B. The location and elimination of trouble in a particular unit can usually be traced to one or more of the following: leaks, either internal or external; foreign particles clogging or holding open a portion of the unit; improper adjustment; mechanical damage; structural failure; or excessive clearance resulting from wear. When the trouble is isolated to a particular unit, remove the unit from the airplane and install a new unit.

C. When a hydraulic unit has been changed or hydraulic lines have been disconnected, check the affected system under pressure for leaks and proper operation before placing the airplane in service.

D. Tube Leaks and Failures

(1) Trouble in a tubing system may be broadly classified into two groups: leaks and failures.

(2) For flared tube joints, refer to paragraph E for causes of leaks. For flareless joints, refer to paragraph F for causes of leaks.

E. Causes of Leaks at Flared Joints

(1) Poor flare, rough surface, cracks, and splits

(2) Improper wrench torque

(3) Insufficient or improper support of lines

(4) Damage to flares

(5) Foreign material under flares

(6) Badly fitted or mismated parts

(7) Careless assembly

(8) Threads seized or galled

F. Causes of Leaks at Flareless Joints

(1) Improper wrench torque

(2) Insufficient or improper support of lines

(3) Foreign material under sleeve

(4) Careless assembly

G. Causes of Leaks at Straight Threaded Joints Using O-rings

(1) Improper positioning of O-ring on fitting

(2) Fitting not properly positioned in boss

(3) Insufficient wrench torque to squeeze O-ring and make seal

(4) Careless assembly

H. Tubing Failures

(1) Hydraulic tubing is designed to withstand several times the operating pressure to which it is subjected. Vibration resulting from chattering or insufficient support, preloaded fittings, and rubbing contact are the causes of most failures.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352 Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

(4) The main gear bogie beams should be locked in the trail position at all times, except as noted in maintenance procedural steps.

<u>WARNING:</u> WHEN THE AIRPLANE IS ON WING AND FUSELAGE JACKS, THE MAIN GEAR WHEELS ARE CLEAR OF THE GROUND, AND THE HYDRAULIC POWER SYSTEM IS PRESSURIZED, THE AFT BOGIE AND WHEELS WILL SWING OUTBOARD VERY RAPIDLY IN THE DIRECTION OF NOSEWHEEL TURN IF THE NOSEWHEELS ARE TURNED MORE THAN 40 DEGREES. BOGIE AND MAIN GEAR AFT WHEELS WILL RETURN TO TRAIL POSITION JUST AS RAPIDLY WHEN THE NOSEWHEELS ARE RETURNED TO NEUTRAL POSITION. THIS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING NEAR THE WHEELS.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. <u>Pressurize/Depressurize Hydraulic System</u>

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

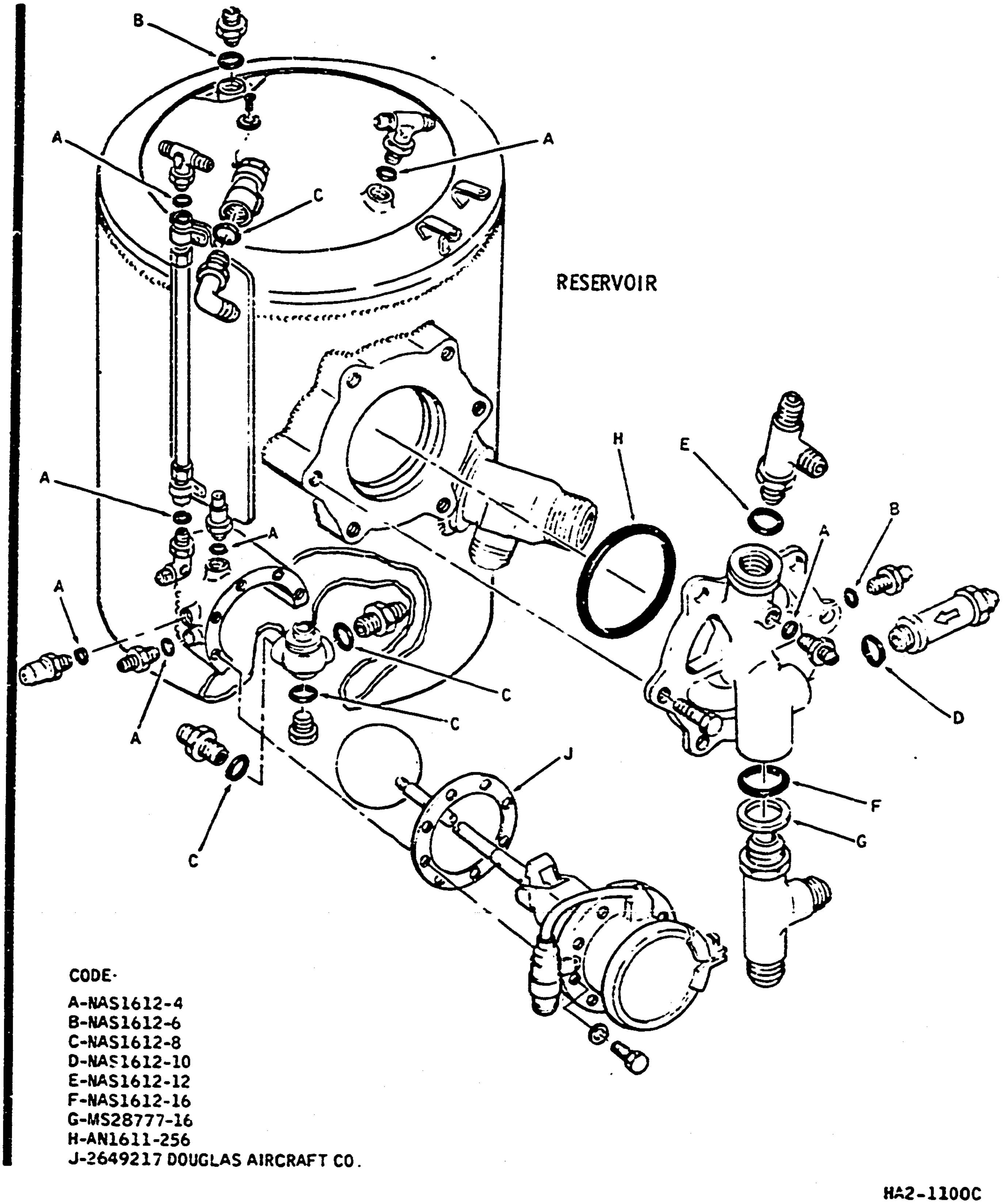
(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

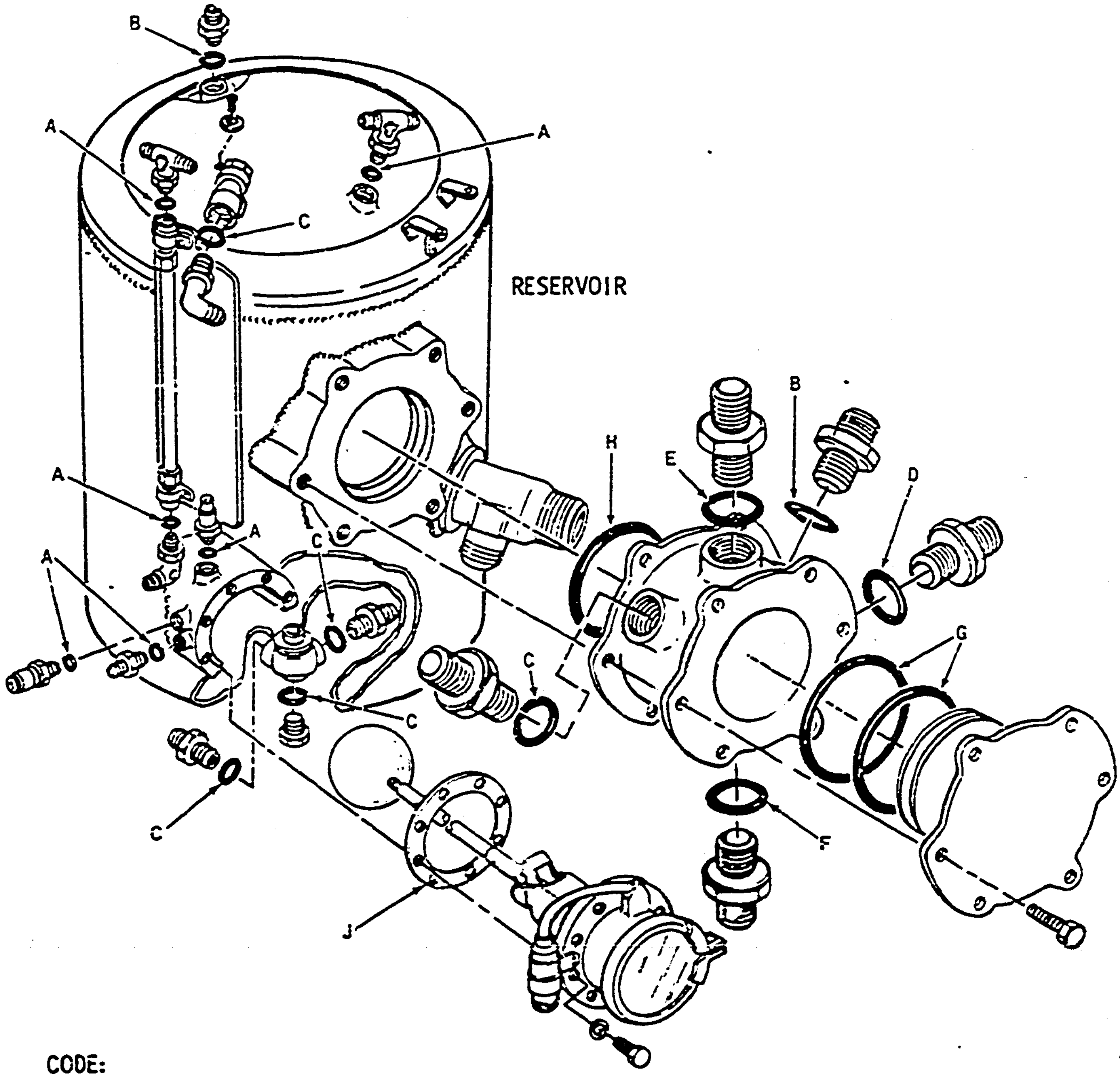
(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.



Hydraulic Power System Components -- O-rings
(Airplanes N8070U-N8075U)
Figure 201 (Sheet 1)

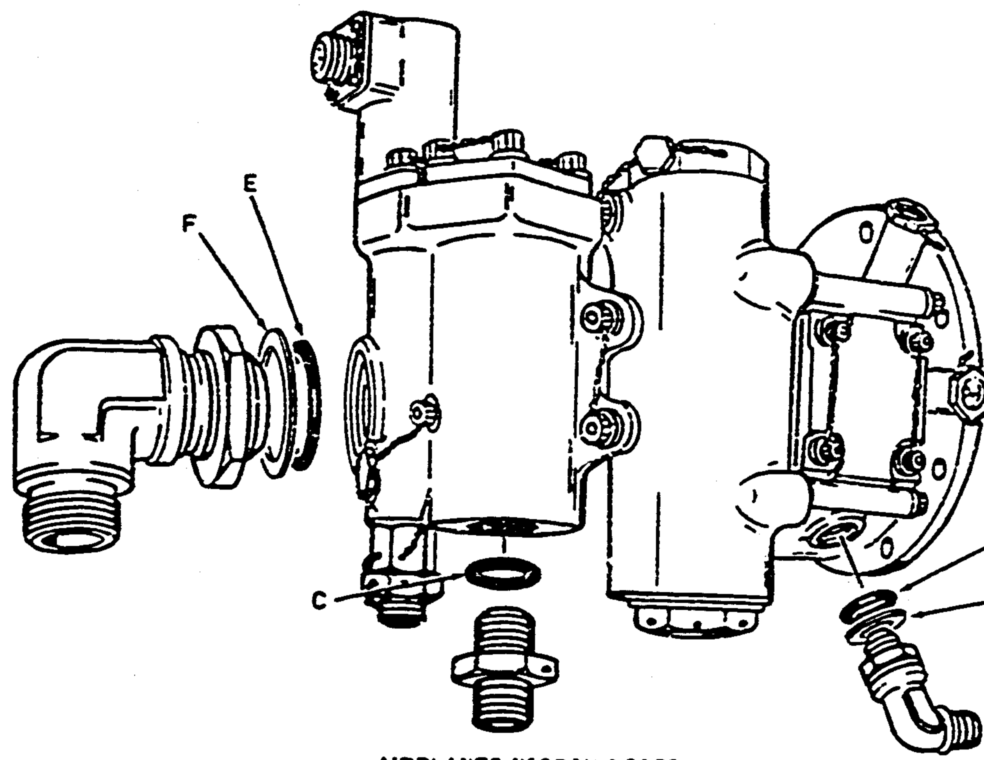


CODE:

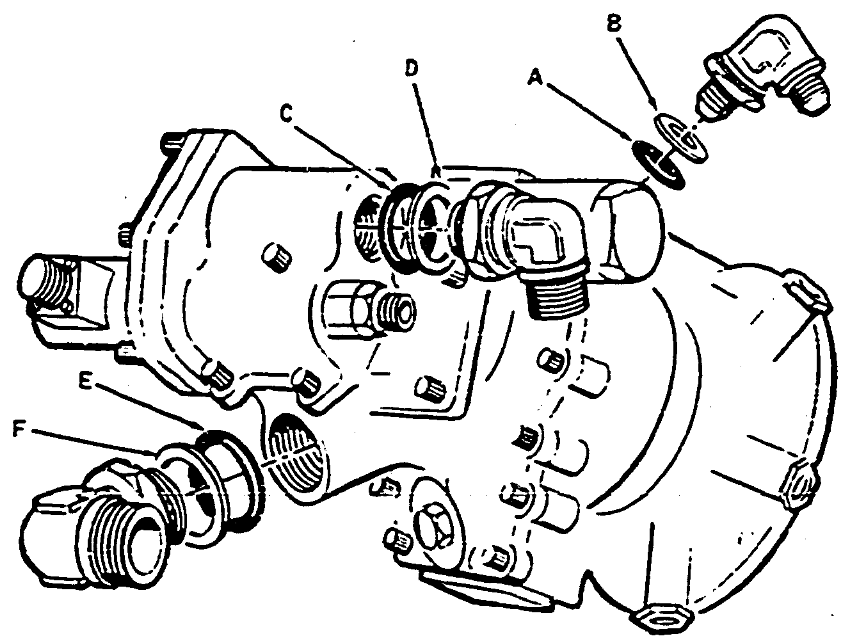
A - NAS 1612-4
B - NAS 1612-6
C - NAS 1612-8
D - NAS 1612-10
E - NAS 1612-12
F - NAS 1612-16
G - NAS 1611-251
H - NAS 1612-256
J - 2649217 DOUGLAS AIRCRAFT CO.

HA2-3676C

Hydraulic Power System Components -- O-rings
(Airplanes N8076U and Subsequent)
Figure 201 (Sheet 2)



AIRPLANES N8070U-N8082U



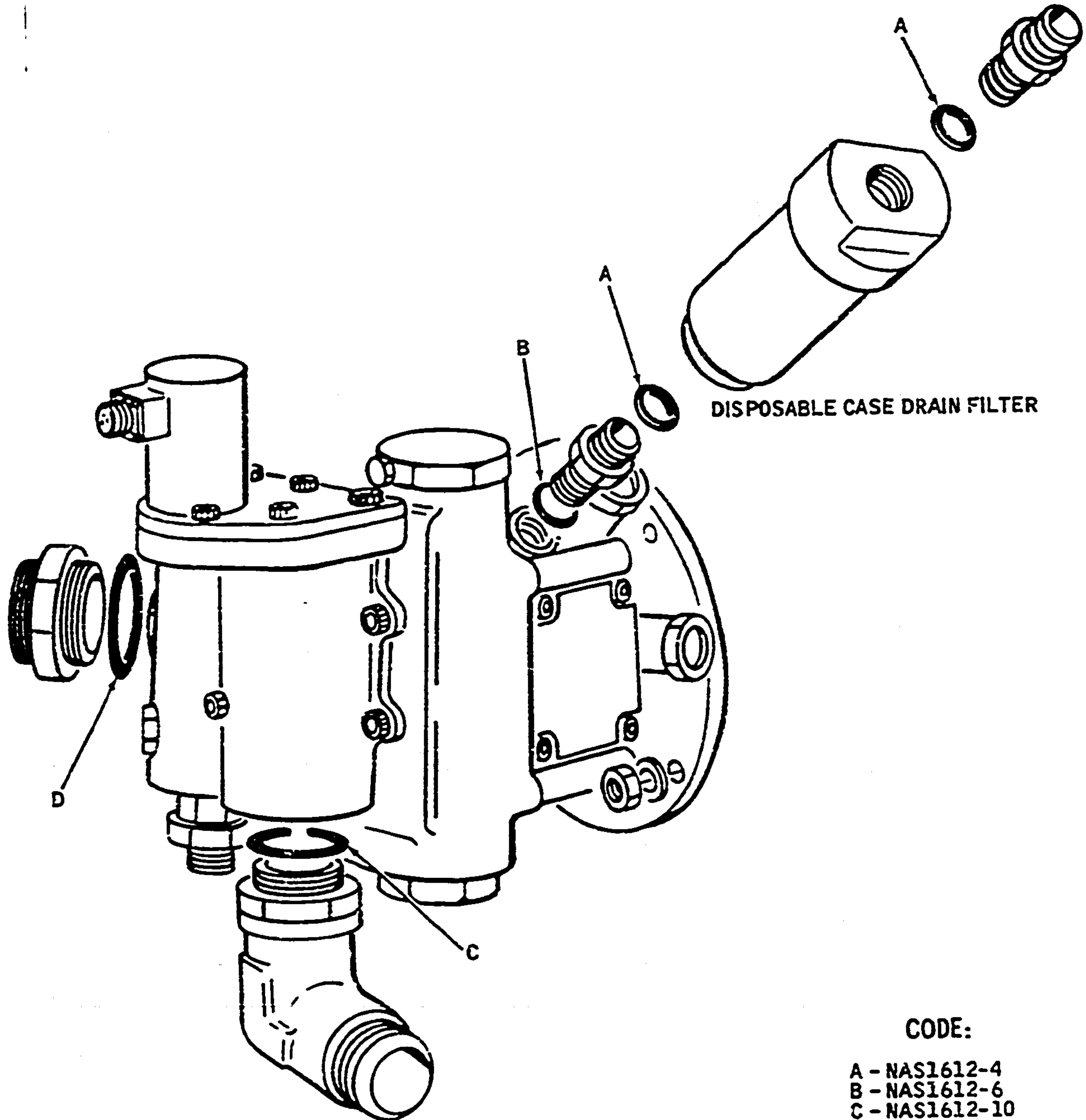
AIRPLANES N8083U-N8099U

A - NAS 1612-6
B - MS28777-6*
C - NAS 1612-10
D - MS28777-10*
E - NAS 1612-20
F - MS28777-20*

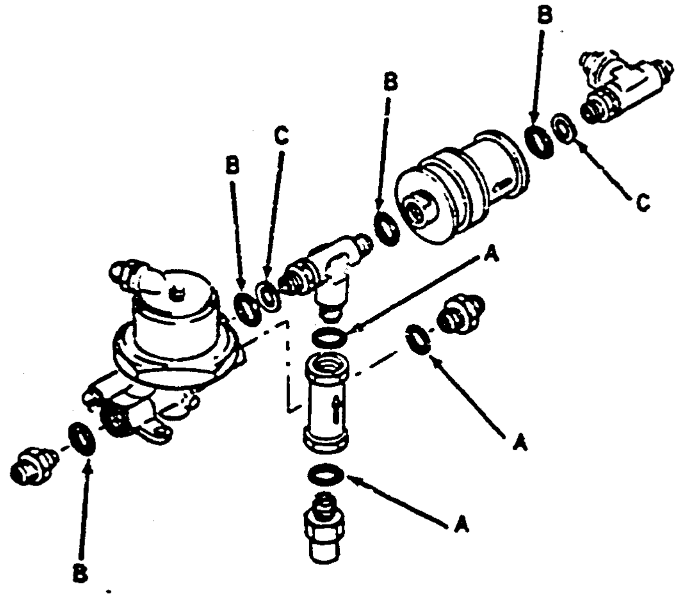
*BACKUP RING

HA2-4465A

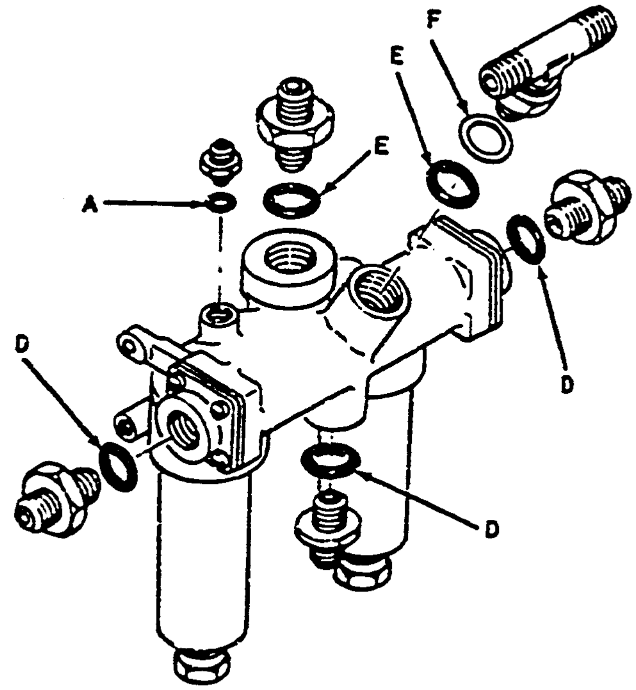
Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 3)



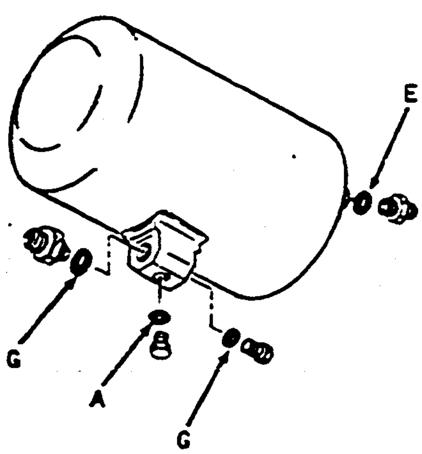
Hydraulic Power System Components -- O-Rings
(Airplanes N8966U and Subs)
Figure 201 (Sheet 3A)



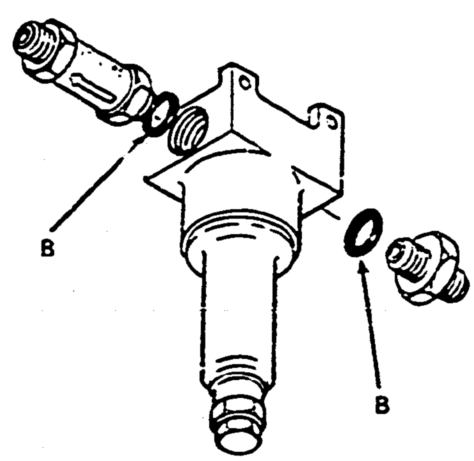
REGULATOR - ASPIRATOR AND AIR FILTERS



DUAL-FILTER & RELIEF VALVE



HYDRAULIC RESERVOIR AIR CHAMBER



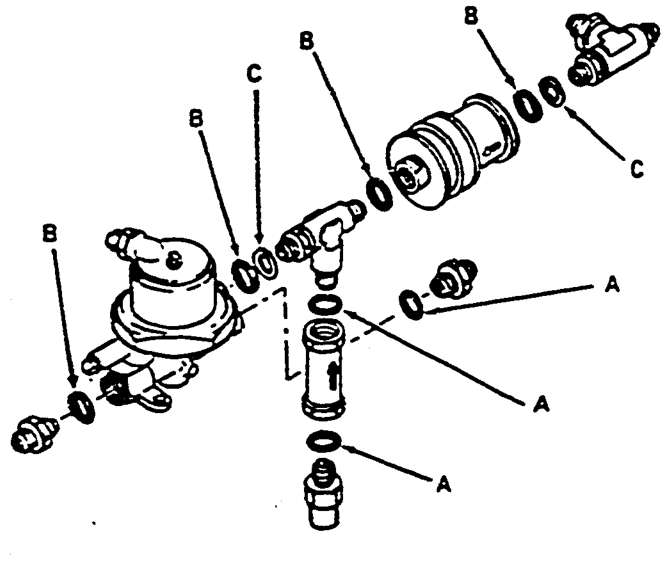
HYDRAULIC PUMPCASE DRAIN FILTER

CODE:

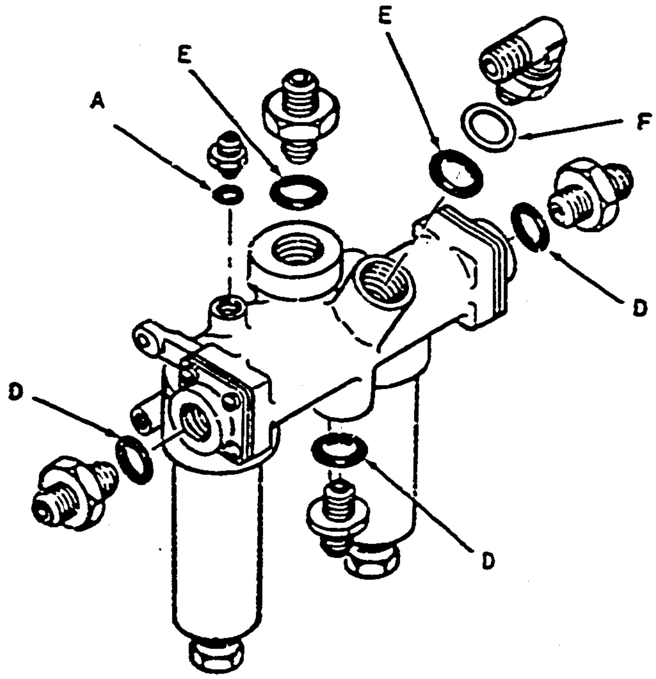
A - NAS1612-4
B - NAS1612-6
C - MS28777-6*
D - NAS1612-10
E - NAS1612-12
F - MS28777-12*
G - NAS1612-16
* - BACKUP RING

HA2-1101A

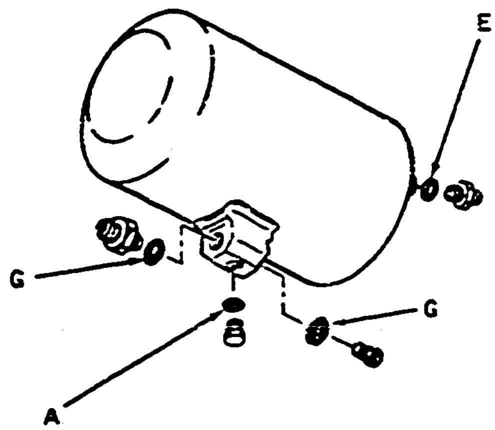
Hydraulic Power System Components -- O-Rings
(Airplanes N8070U-N8099U)
Figure 201 (Sheet 4)



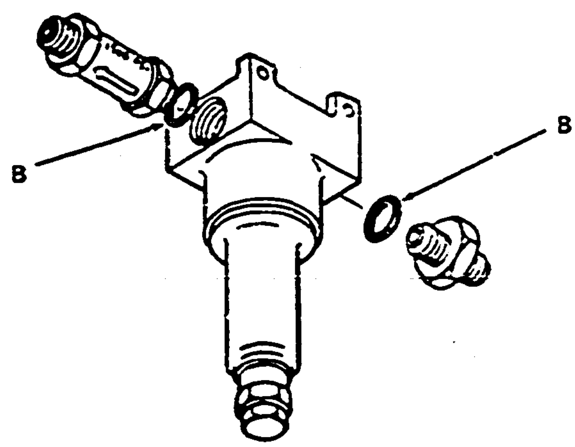
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



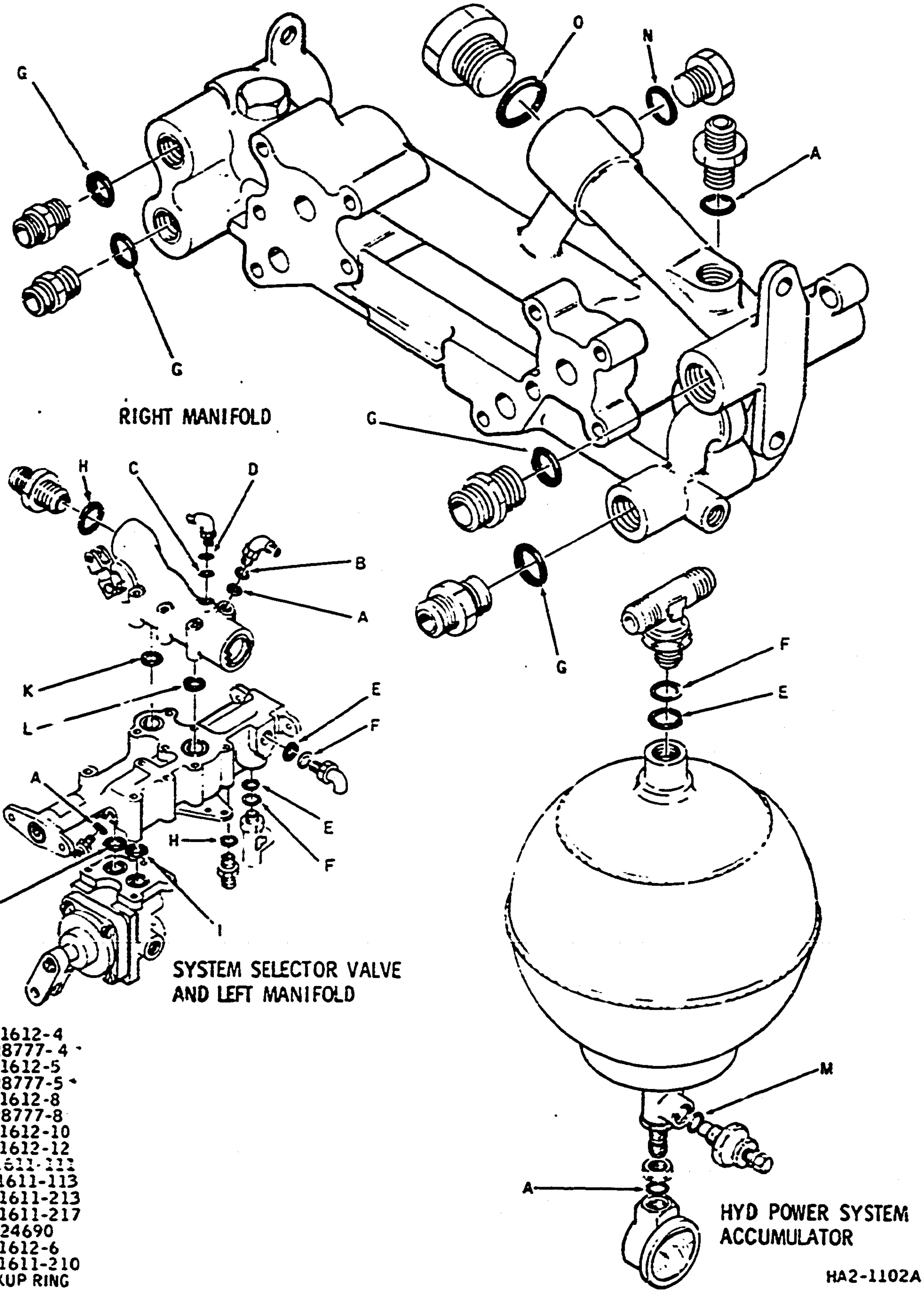
HYDRAULIC
PUMPCASE DRAIN
FILTER

CODE

A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16
* - BACKUP RING

HA2-3415B

Hydraulic Power System Components -- O-Rings
(Airplanes N8966U and Subsequent)
Figure 201 (Sheet 4A)



CODE:
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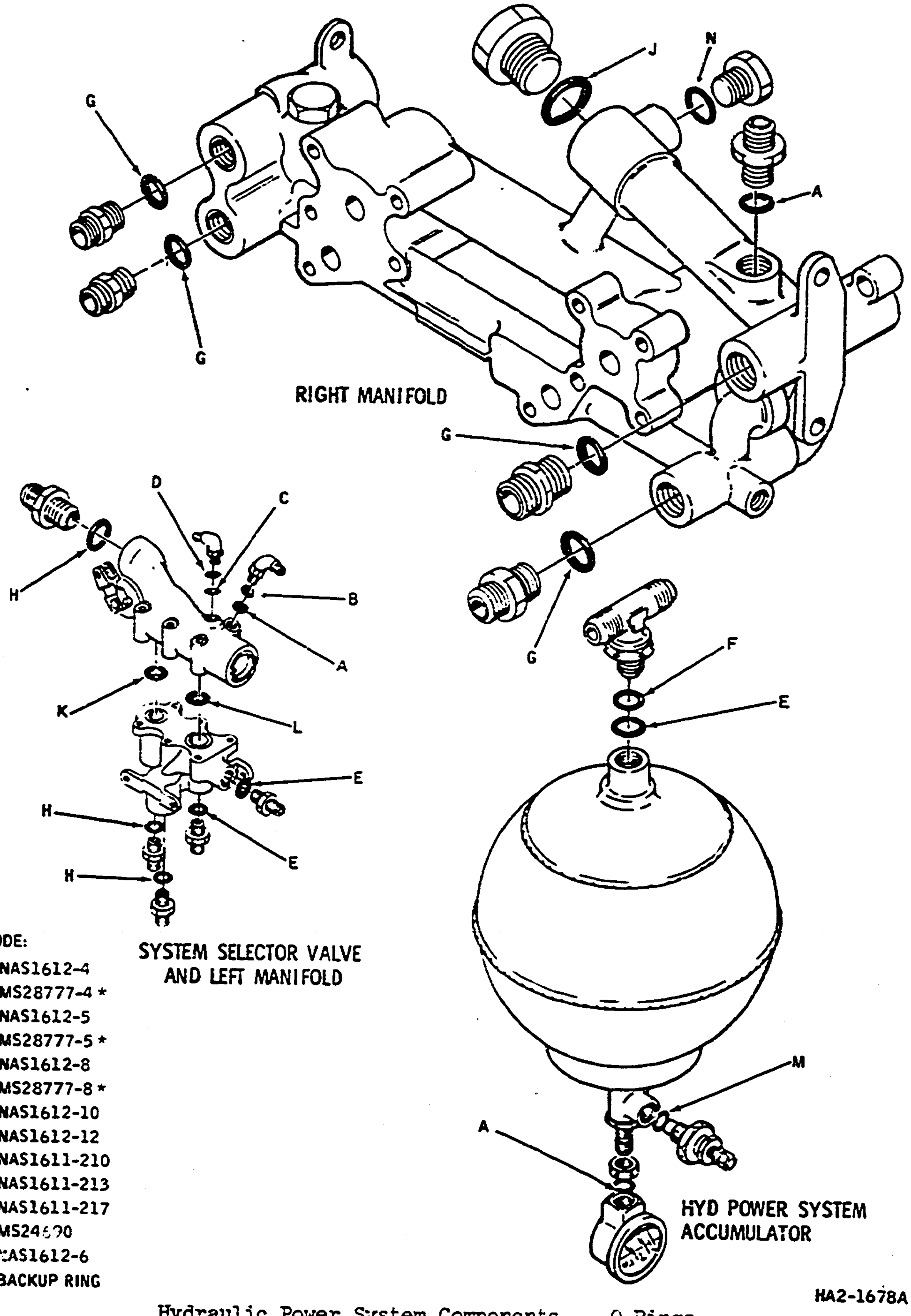
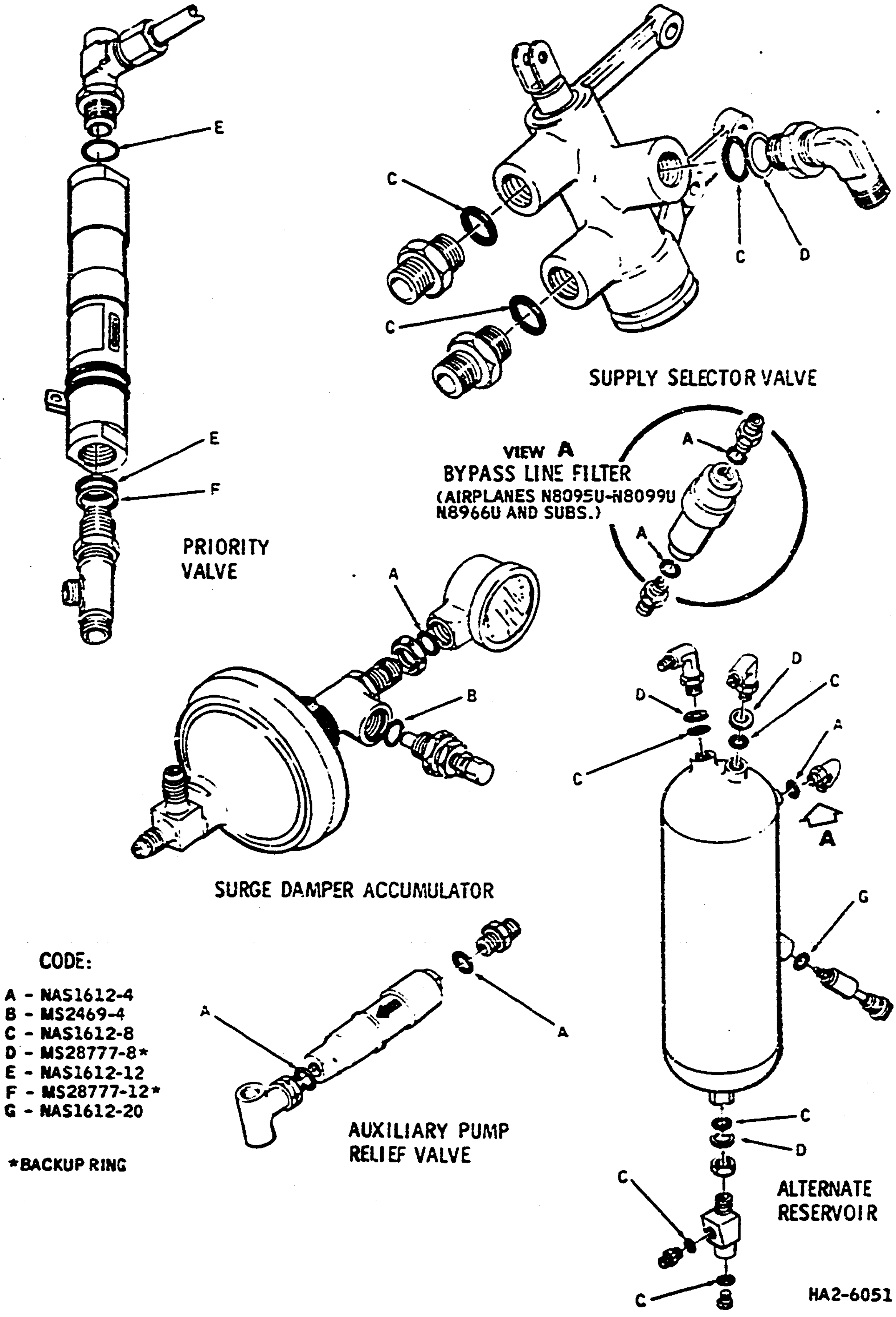
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8
G-NAS1612-10
H-NAS1612-12
I-NAS1611-111
J-NAS1611-113
K-NAS1611-213
L-NAS1611-217
M-MS-24690
N-NAS1612-6
O-NAS1611-210
*-BACKUP RING

Hydraulic Power System Components -- O-Rings
(Airplanes N8070U-N8099U)
Figure 201 (Sheet 5)



CODE:
A-NAS1612-4
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

Hydraulic Power System Components -- O-Rings
(Airplanes N8966U and Subsequent)
Figure 201 (Sheet 5A)

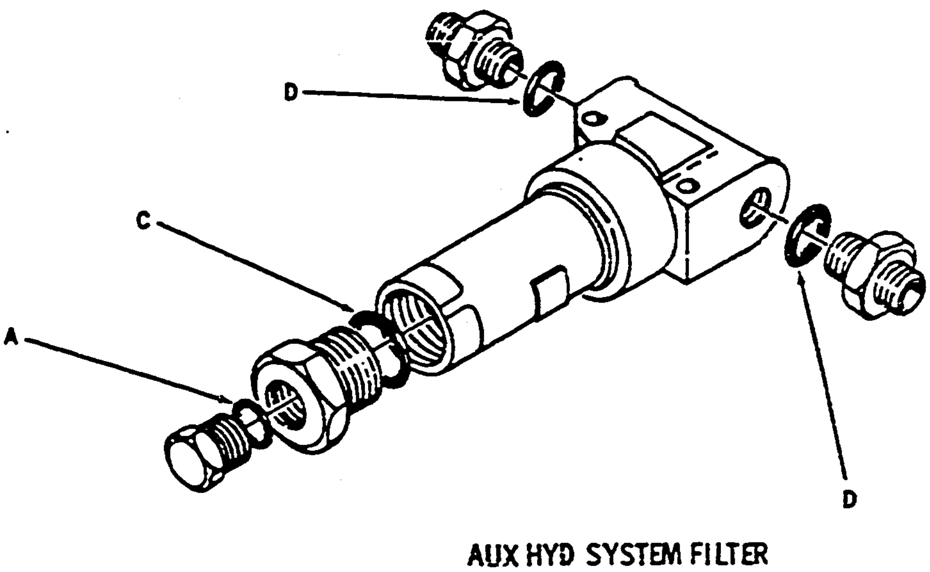


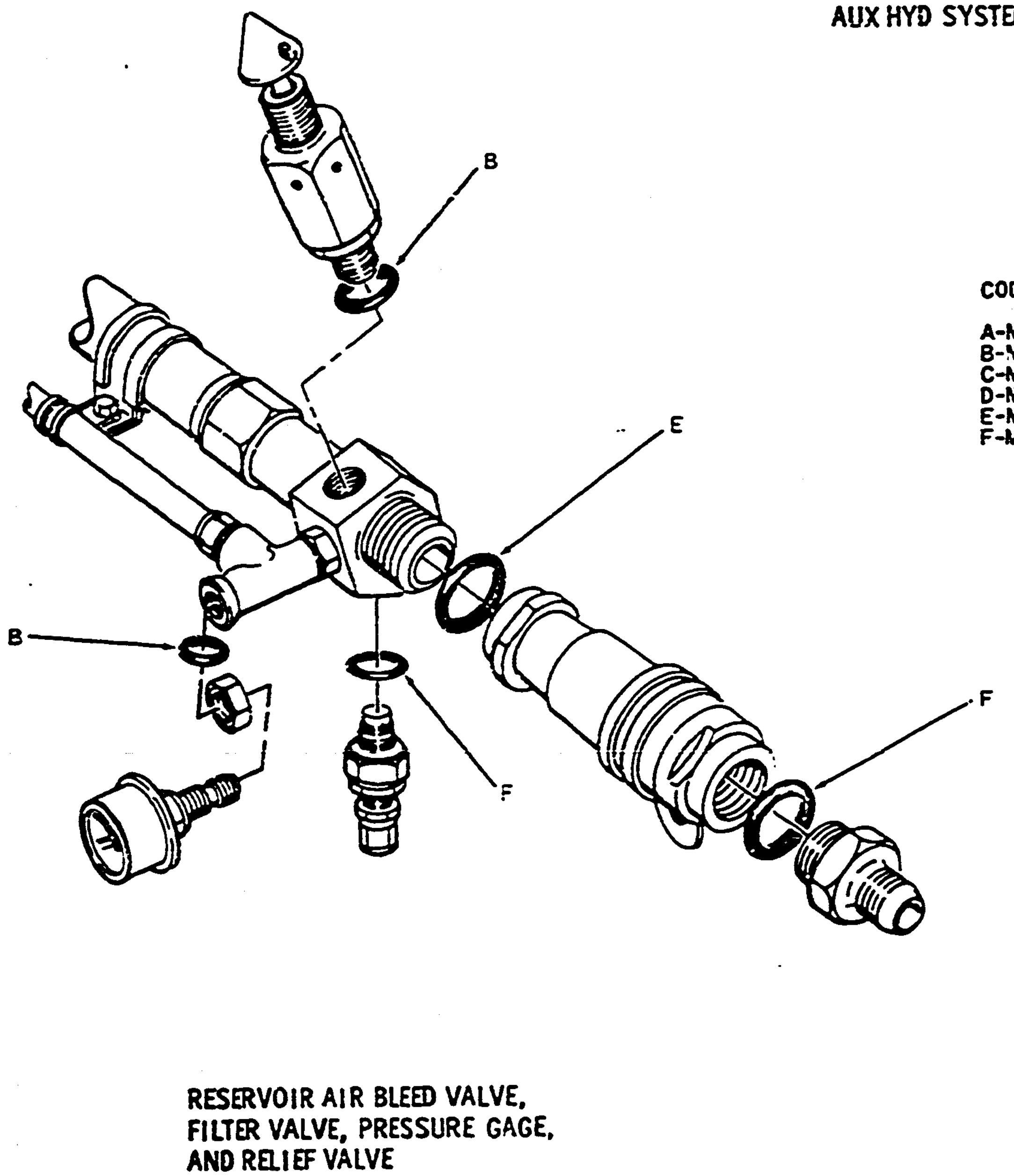
CODE:

A - NAS1612-4
B - MS2469-4
C - NAS1612-8
D - MS28777-8*
E - NAS1612-12
F - MS28777-12*
G - NAS1612-20

*BACKUP RING

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 6)

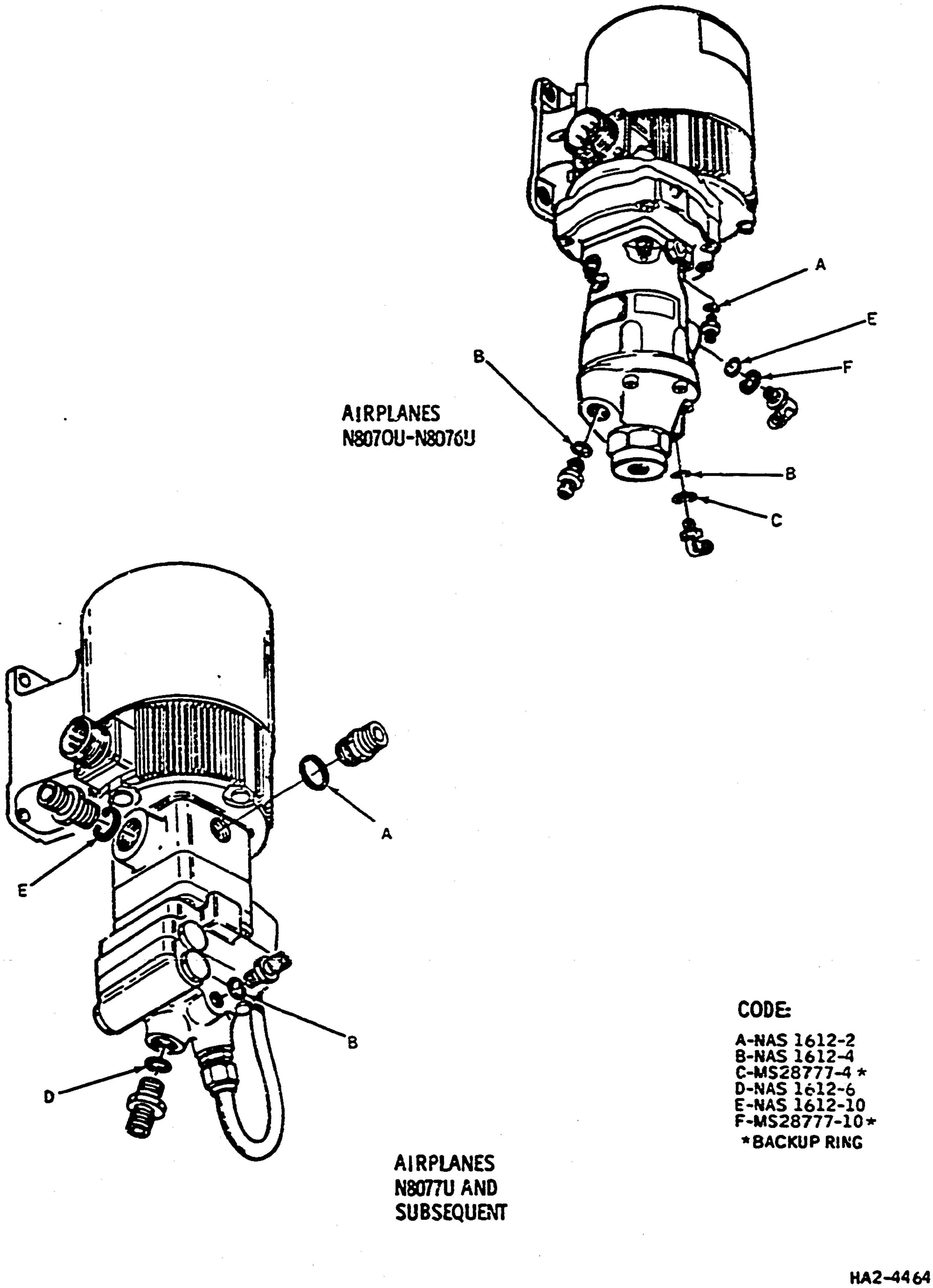




CODE:

A-NAS1612-2
B-NAS1612-4
C-NAS1612-6
D-NAS1612-8
E-NAS1612-12
F-MS24690

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 7)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 8)

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

<u>WARNING:</u> BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System With Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

<u>WARNING:</u> BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

<u>CAUTION:</u> DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depresurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System With Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hudraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located in the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are

mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD 'AN' VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 ([illegible]) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system

with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed (airplanes N8966U and subsequent).

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged, deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

<u>CAUTION</u>: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) On airplanes N8966U and subsequent, the thrust reverser system is hydraulically actuated and is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under finger nails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Company, or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be checked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

(4) The main gear bogie beams should be locked in the trail position at all times, except as noted in maintenance procedural steps.

WARNING: WHEN THE AIRPLANE IS ON WING AND FUSELAGE JACKS, THE MAIN GEAR WHEELS ARE CLEAR OF THE GROUND, AND THE HYDRAULIC POWER SYSTEM IS PRESSURIZED, THE AFT BOGIE AND WHEELS WILL SWING OUTBOARD VERY RAPIDLY IN THE DIRECTION OF NOSEWHEEL TURN IF THE NOSEWHEELS ARE TURNED MORE THAN 40 DEGREES. BOGIE AND MAIN GEAR AFT WHEELS WILL RETURN TO TRAIL POSITION JUST AS RAPIDLY WHEN THE NOSEWHEELS ARE RETURNED TO NEUTRAL POSITION. THIS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING NEAR THE WHEELS.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

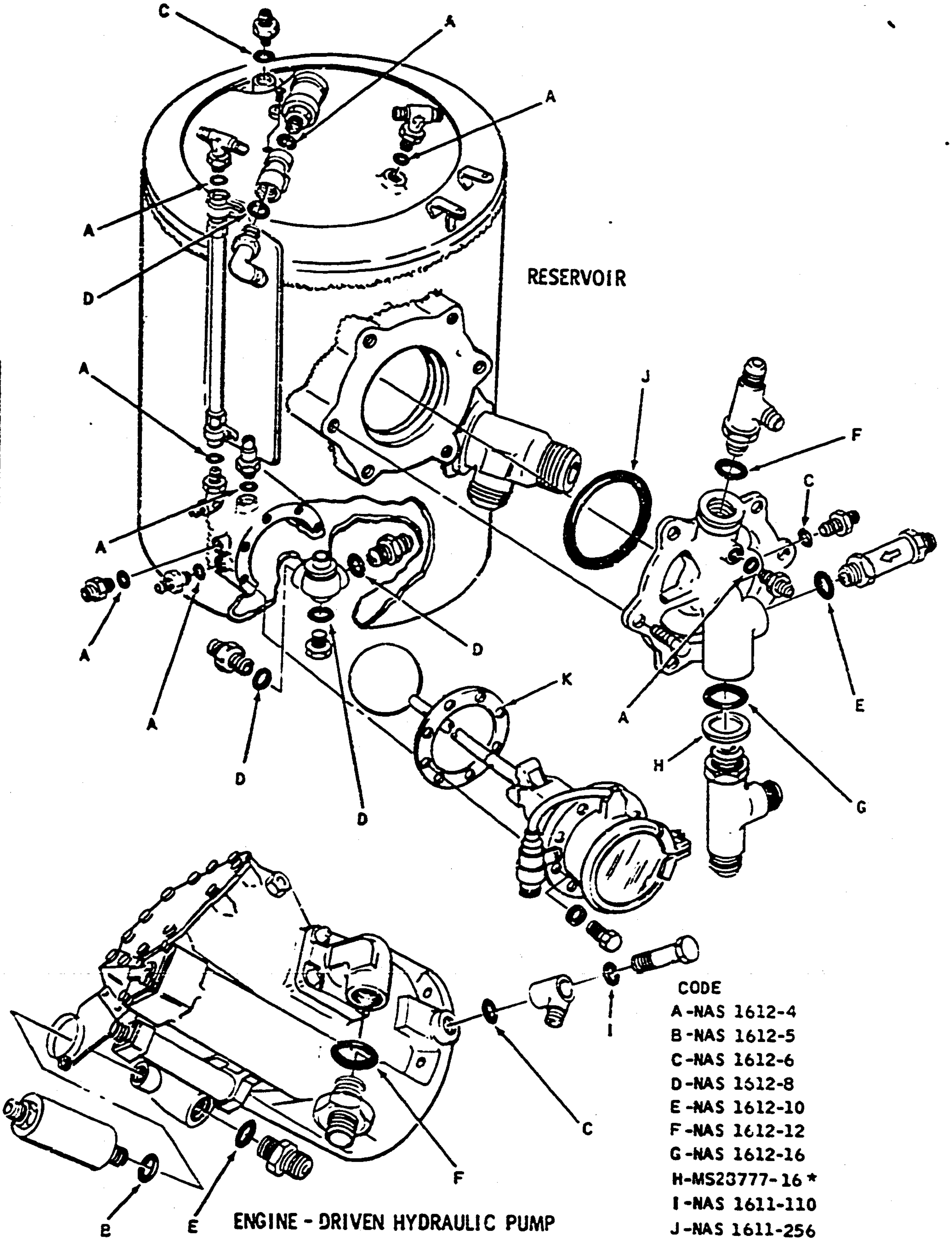
(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.



CODE
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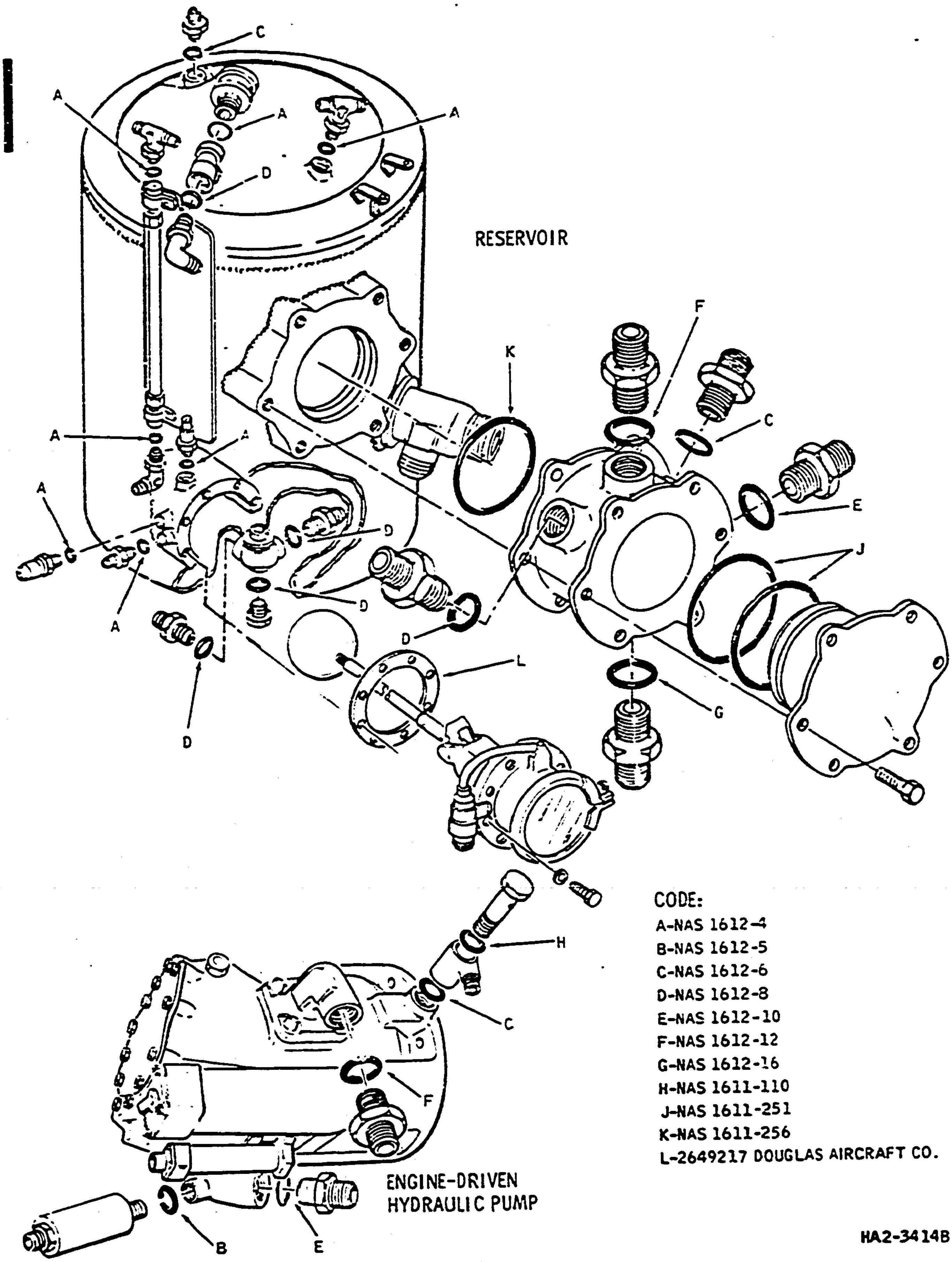
B-NAS 1612-5
C-NAS 1612-6
D-NAS 1612-8
E-NAS 1612-10
F-NAS 1612-12
G-NAS 1612-16
H-MS28777-16 *
I-NAS 1611-110
J-NAS 1611-256
K-2649217 DOUGLAS AIRCRAFT CO.

*BACKUP RING HA2-1884A

Hydraulic Power System Components -- O-Rings
(Airplanes N8774-N8778)
Figure 201 (Sheet 1)



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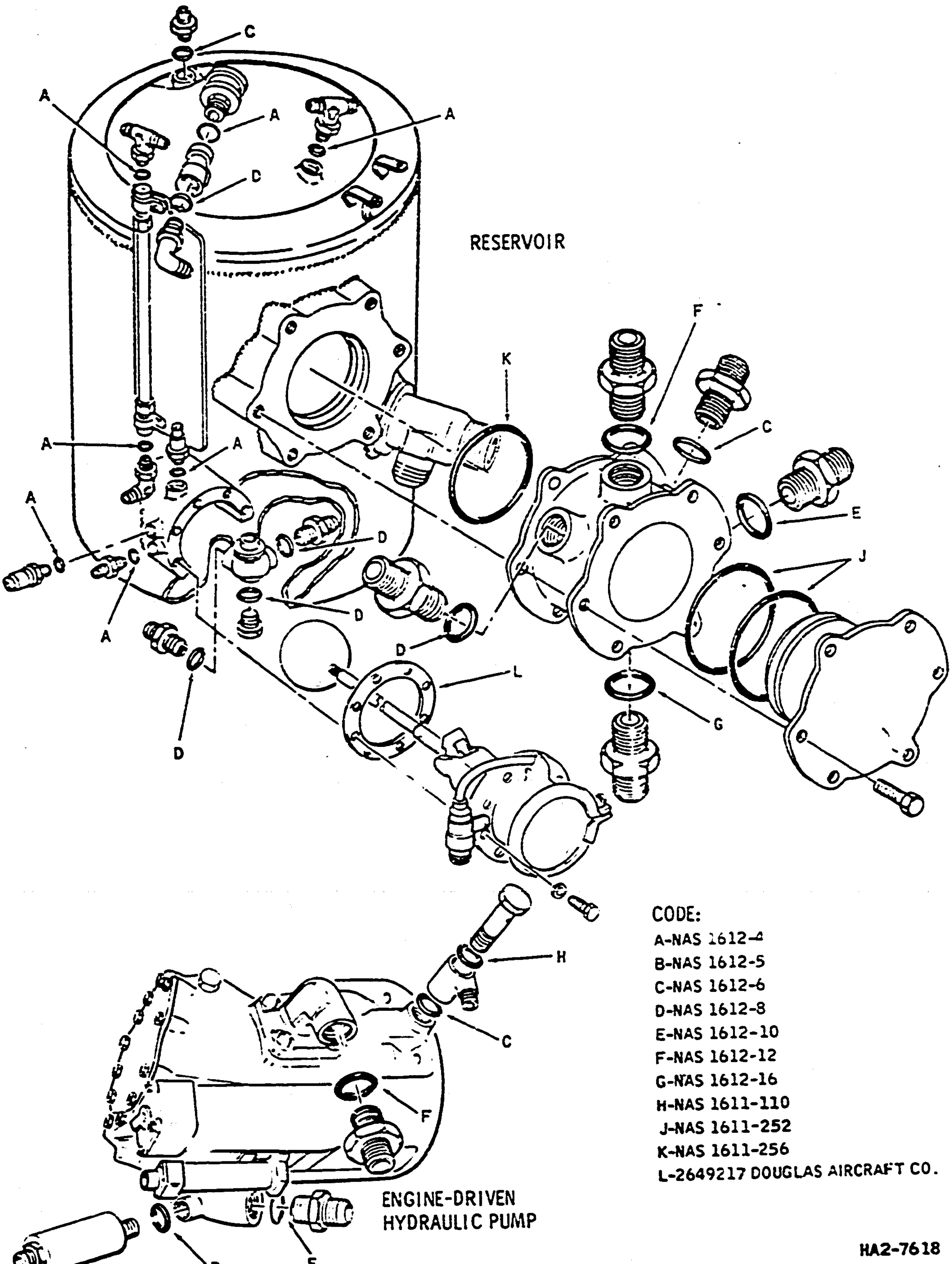
G-NAS 1612-16
H-NAS 1611-110
J-NAS 1611-251
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

Hydraulic Power System Components -- O-Rings
(Airplanes N8755-N8760, N8762-N8769, N8772, N8773)
Figure 201 (Sheet 1A)



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D-NAS 1612-8
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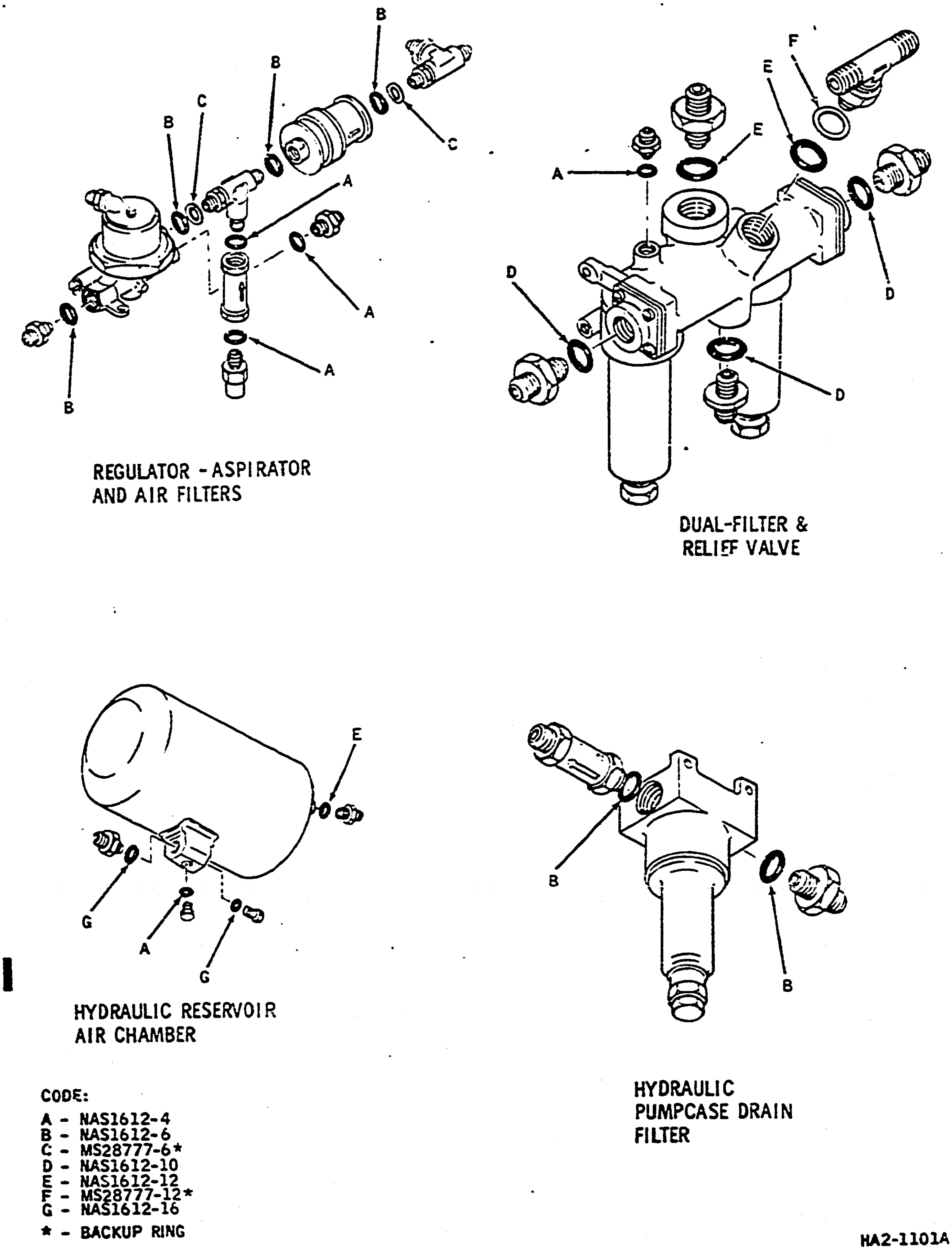
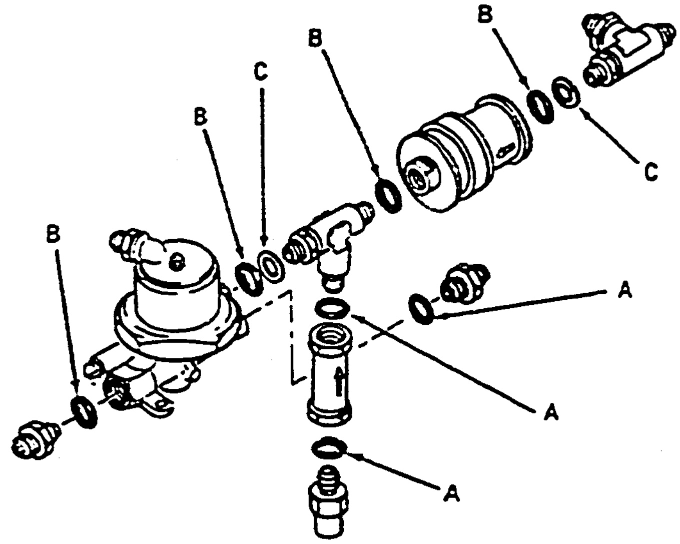
F-NAS 1612-12
G-NAS 1612-16
H-NAS 1611-110
J-NAS 1611-252
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

HA2-7618

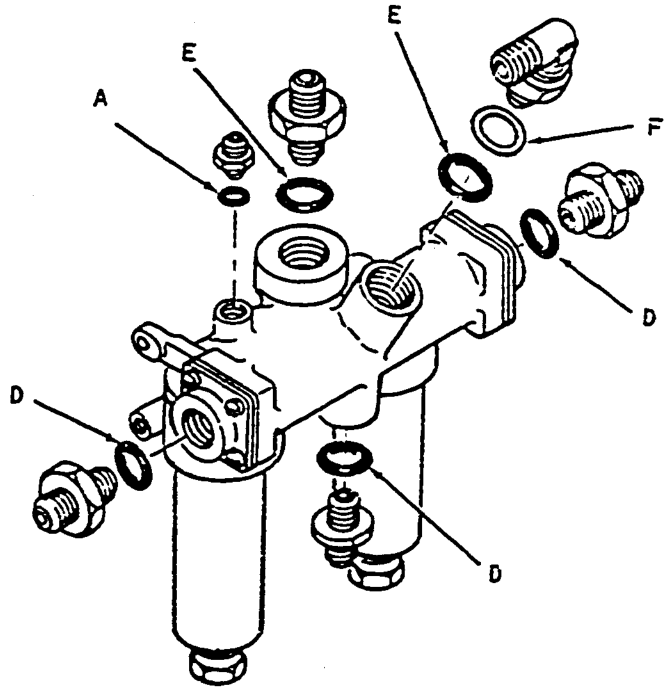
Hydraulic Power System Components -- O-Rings
(Airplanes N8770, N8771)
Figure 201 (Sheet 1B)



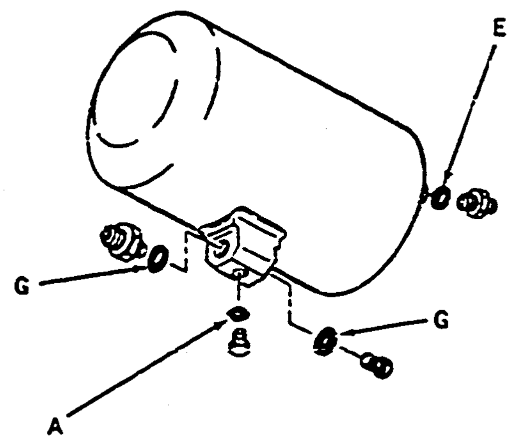
Hydraulic Power System Components -- O-rings
(Airplanes N8762-N8778)
Figure 201 (Sheet 2)



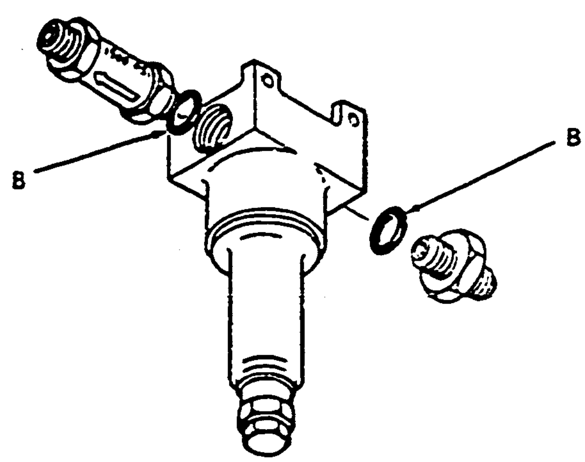
REGULATOR - ASPIRATOR AND AIR FILTERS



DUAL-FILTER & RELIEF VALVE



HYDRAULIC RESERVOIR AIR CHAMBER



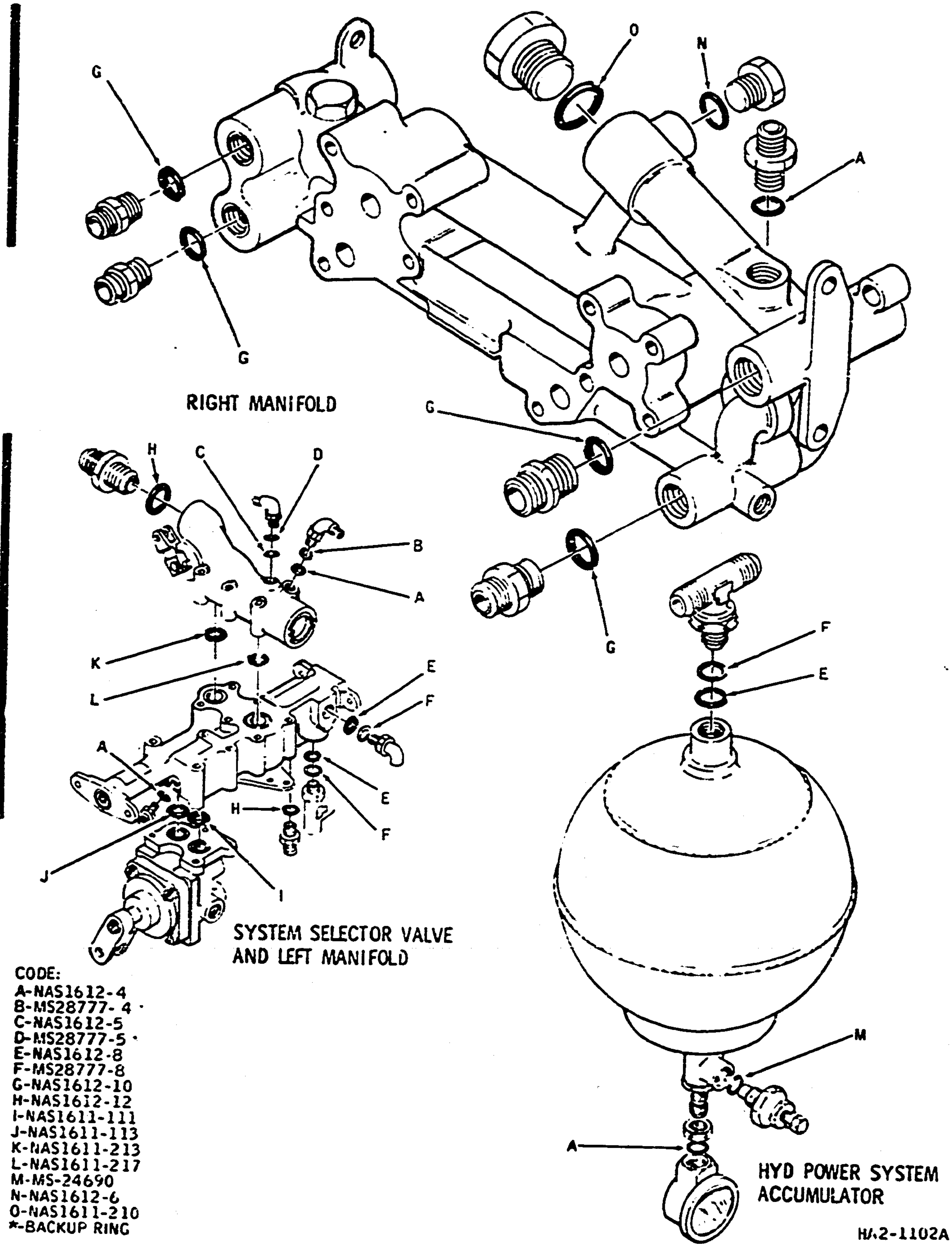
HYDRAULIC PUMPCASE DRAIN FILTER

CODE

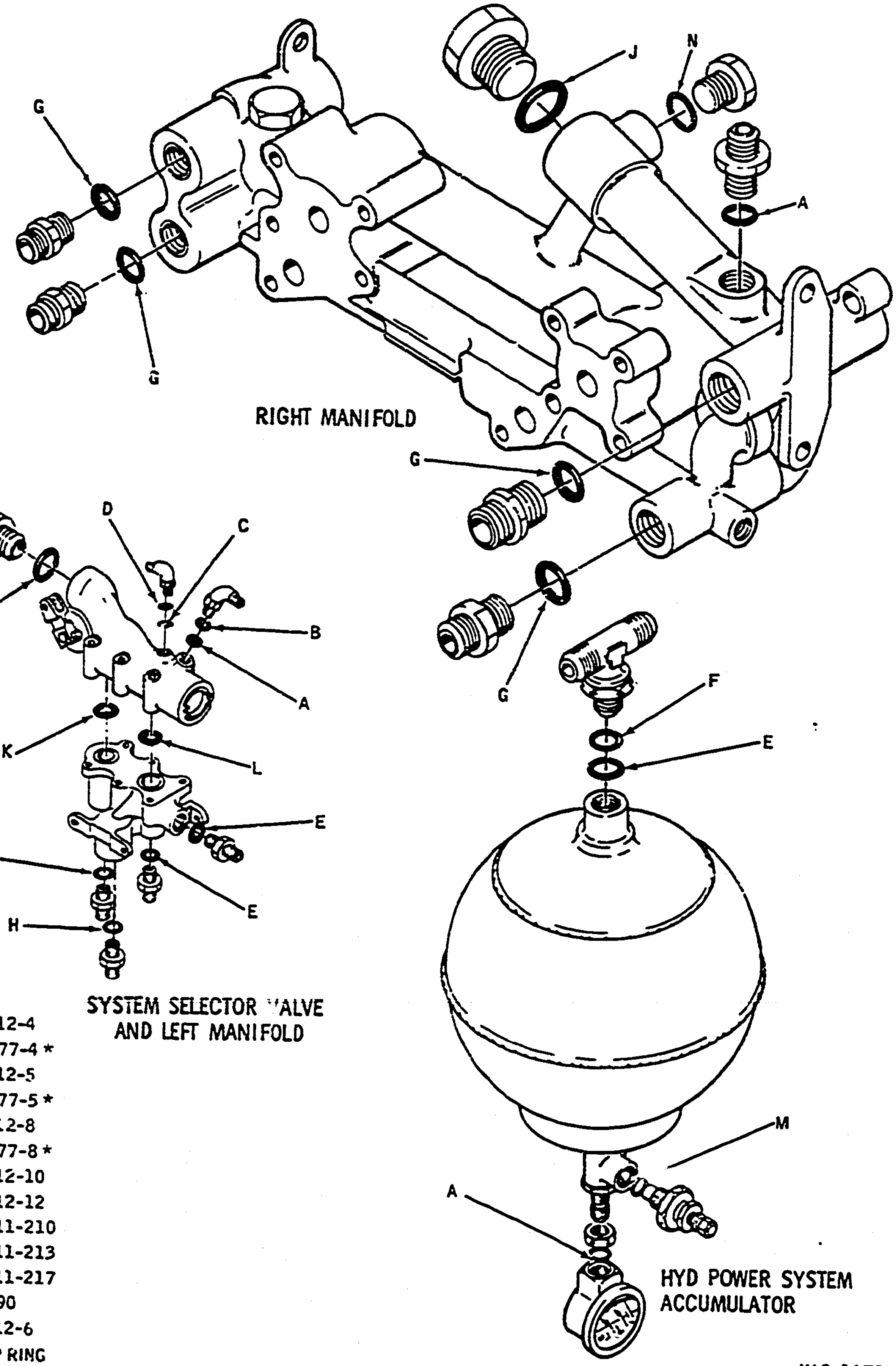
A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16
* - BACKUP RING

HA2-3415B

Hydraulic Power System Components -- O-Rings
(Airplane N8755-N8760)
Figure 201 (Sheet 2A)



Hydraulic Power System Components -- O-rings
(Airplanes N8762-N8778)
Figure 201 (Sheet 3)



CODE:
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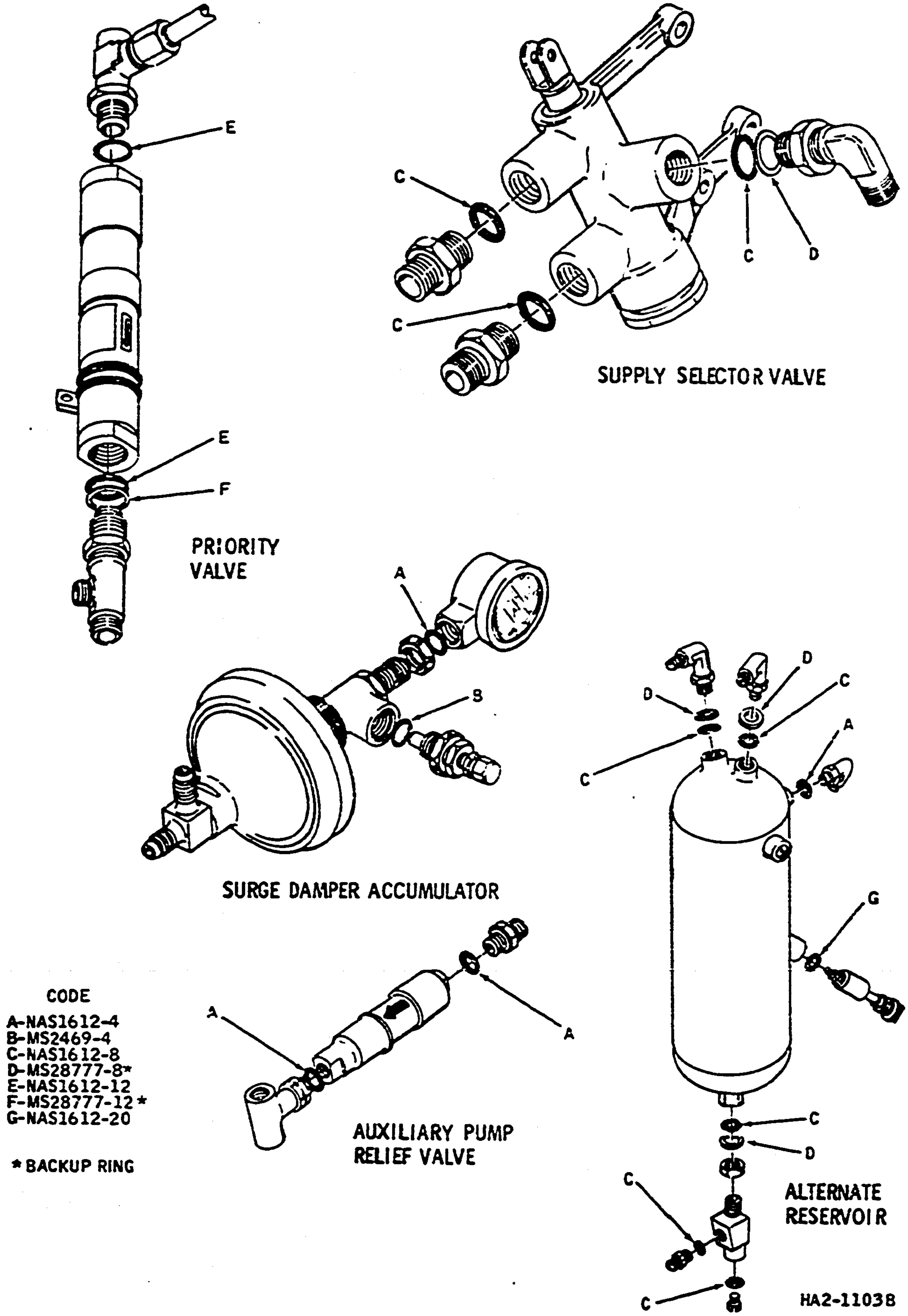
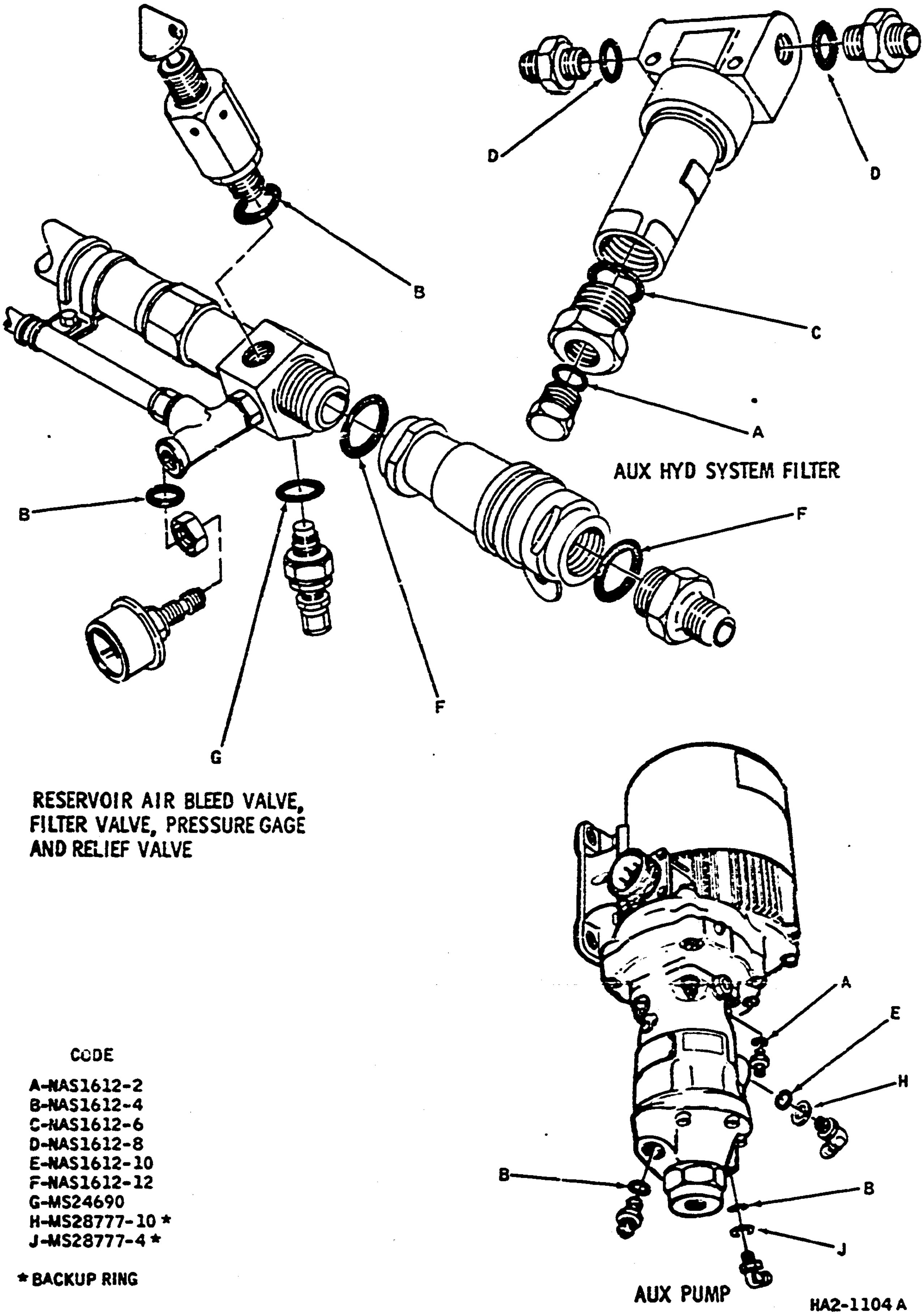
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

HA2-1678A

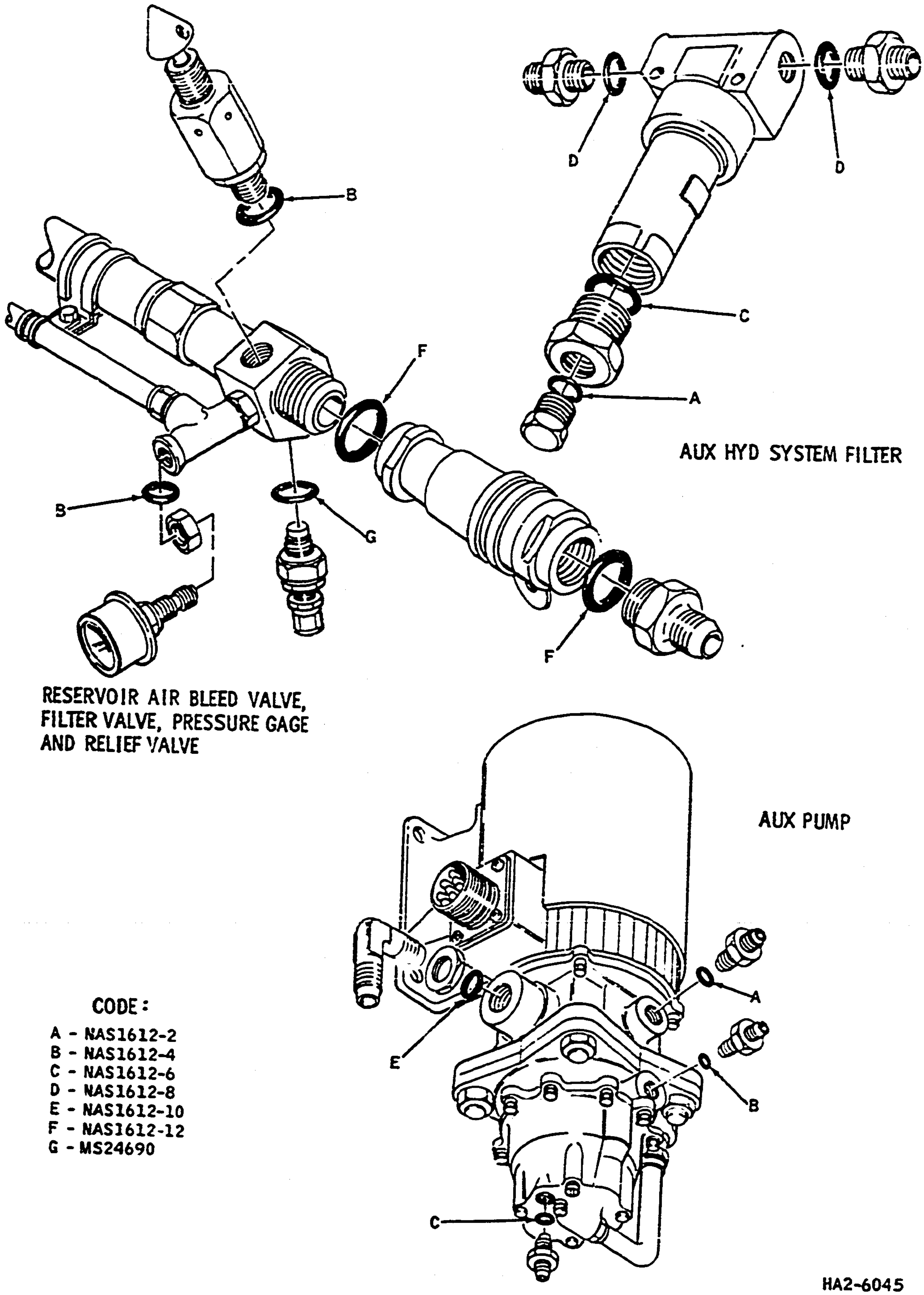
Hydraulic Power System Components -- O-Rings
(Airplane N8755-N8760)
Figure 201 (Sheet 3A)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- O-rings
(Airplanes N8762-N8778)
Figure 201 (Sheet 5)



Hydraulic Power System Components -- O-Rings
(Airplane N8755-N8760)
Figure 201 (Sheet 3A)

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System with Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

NOTE: Besides the two auxiliary hydraulic pump control switches located in the flight compartment, there is a control switch located just aft of the auxiliary pump in the left wing root area for the use of ground personnel.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System with Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

<u>WARNING</u>: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. <u>Pressurize/Depressurize Hydraulic Reservoir</u>

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the

forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines

the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed (airplanes N8755-N8760).

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

<u>CAUTION</u>: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) On airplanes N8755-N8760, the thrust reverser system is hydraulically actuated and is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

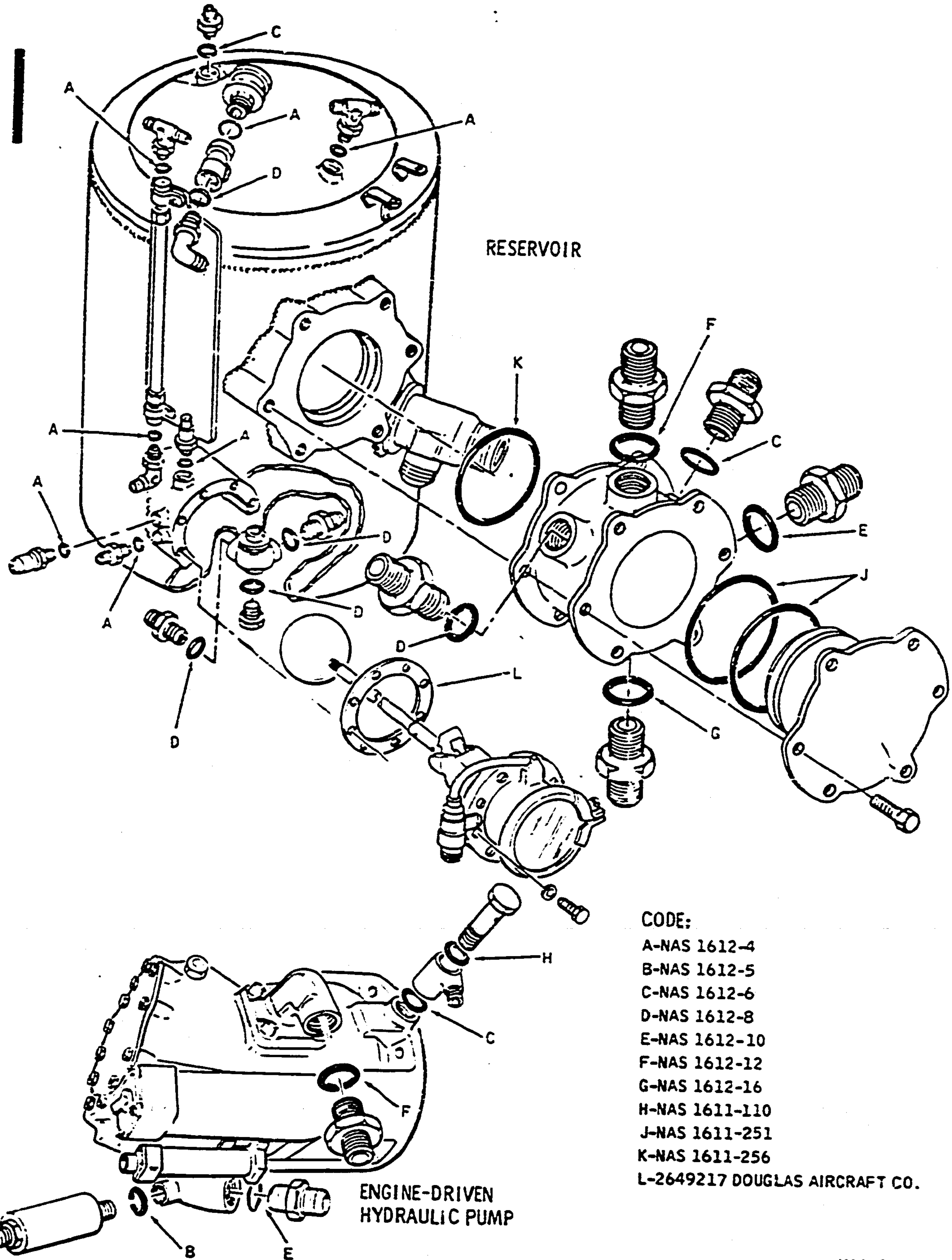
(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

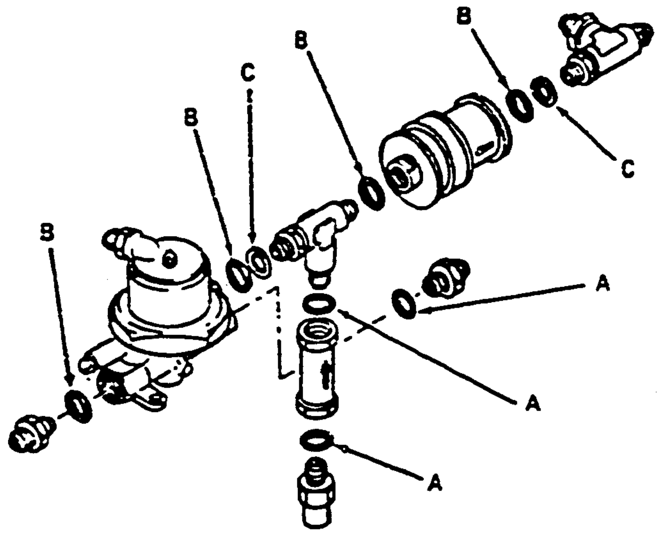
B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

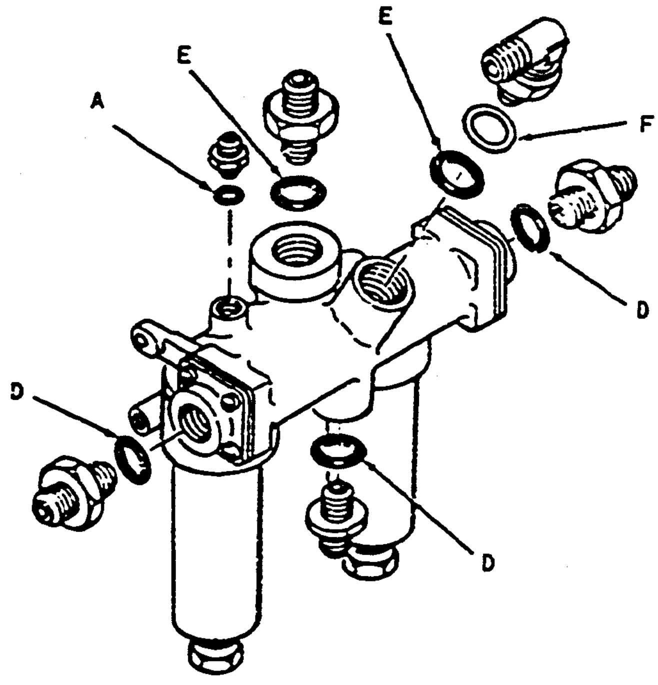
(2) Deenergize test stand hydraulic pump.



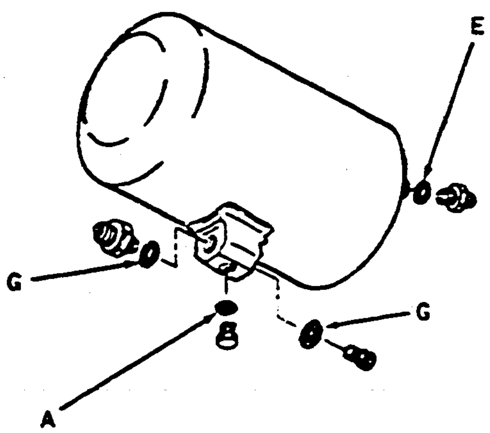
Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



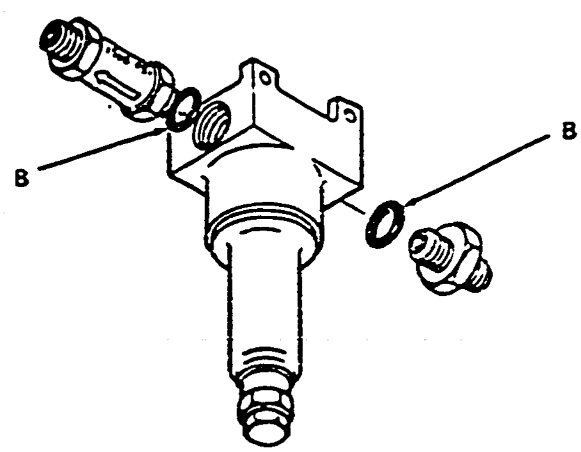
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



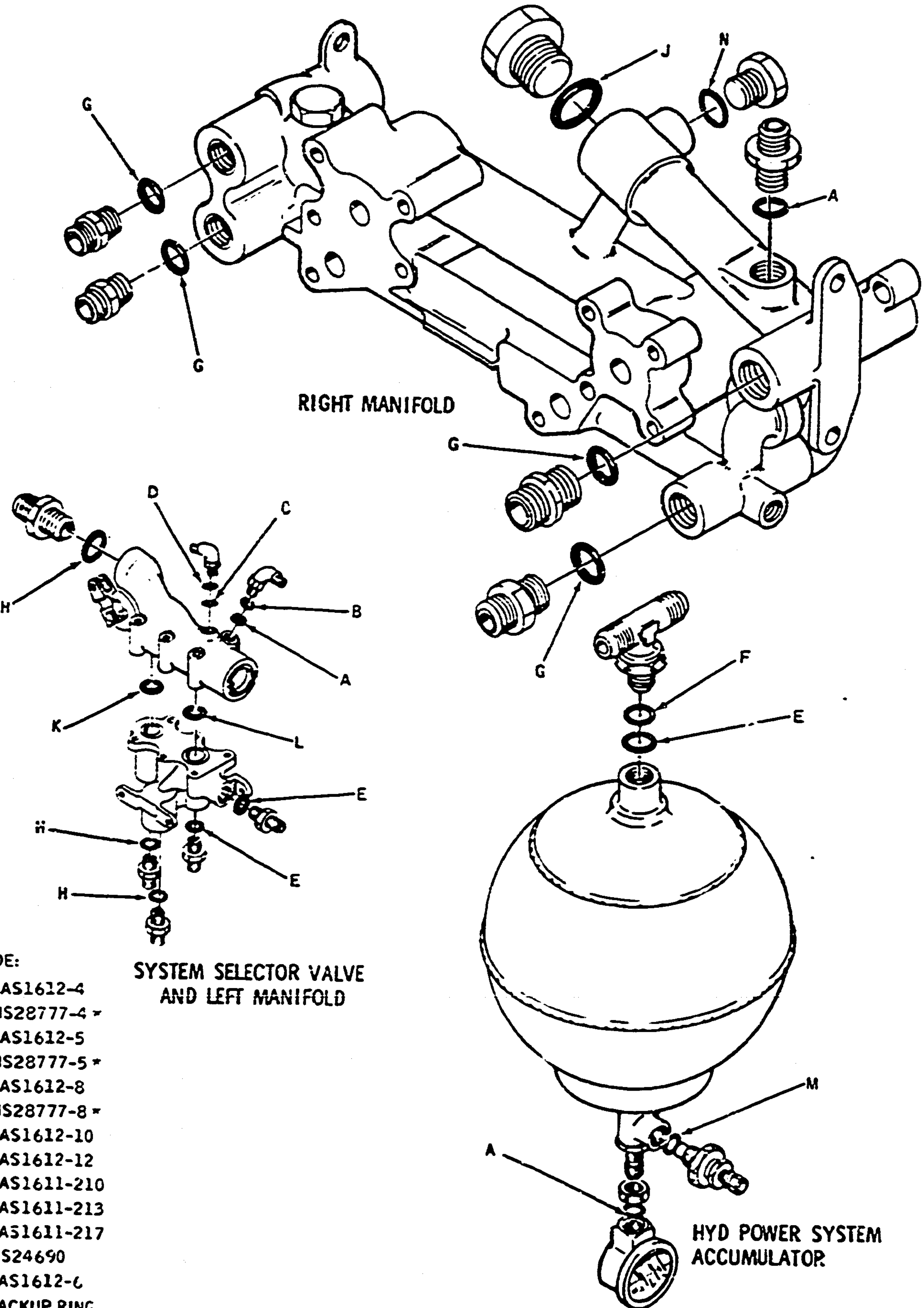
HYDRAULIC
PUMPCASE DRAIN
FILTER

CODE

A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16
* - BACKUP RING

HA2-3415B

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 2)



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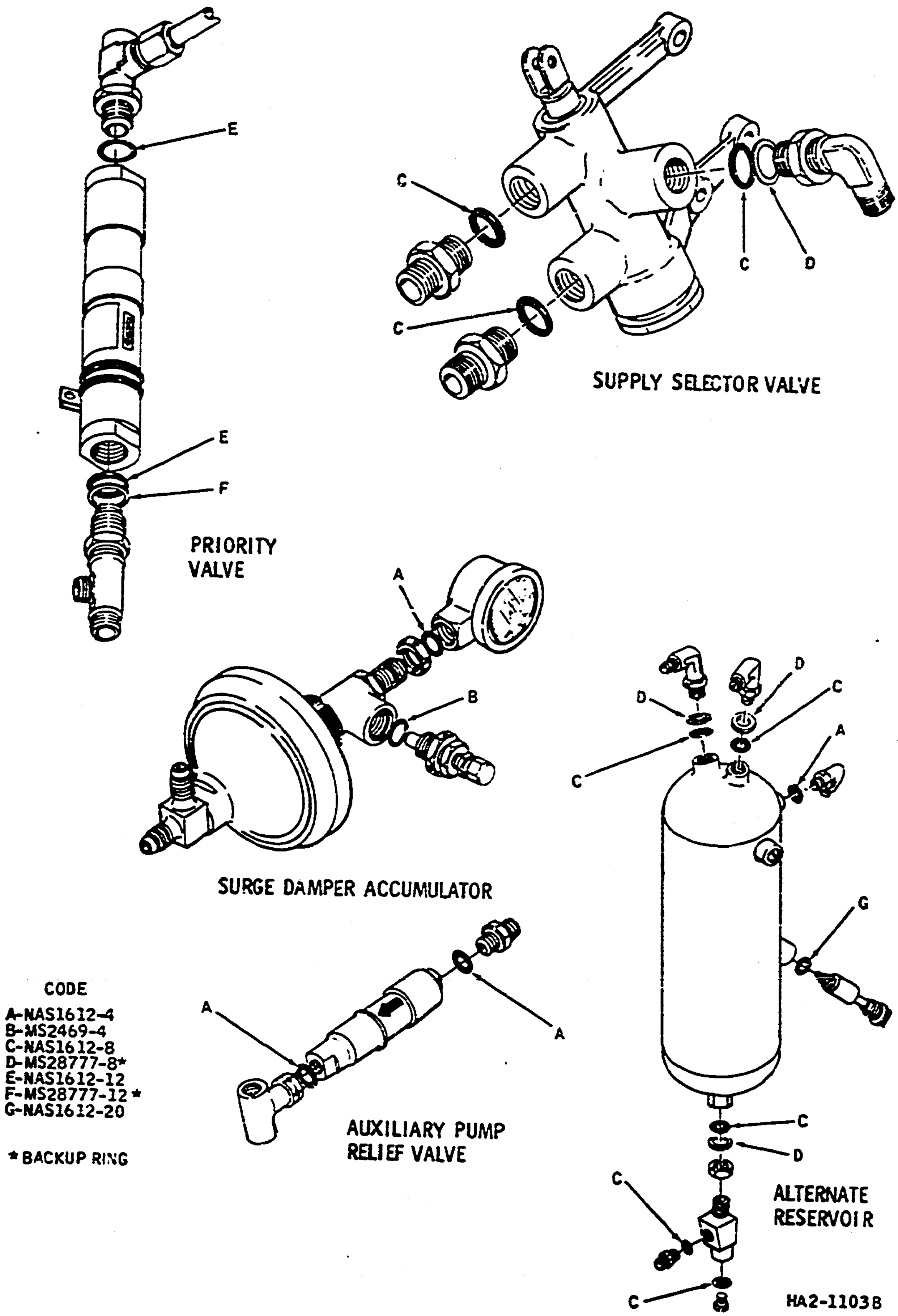
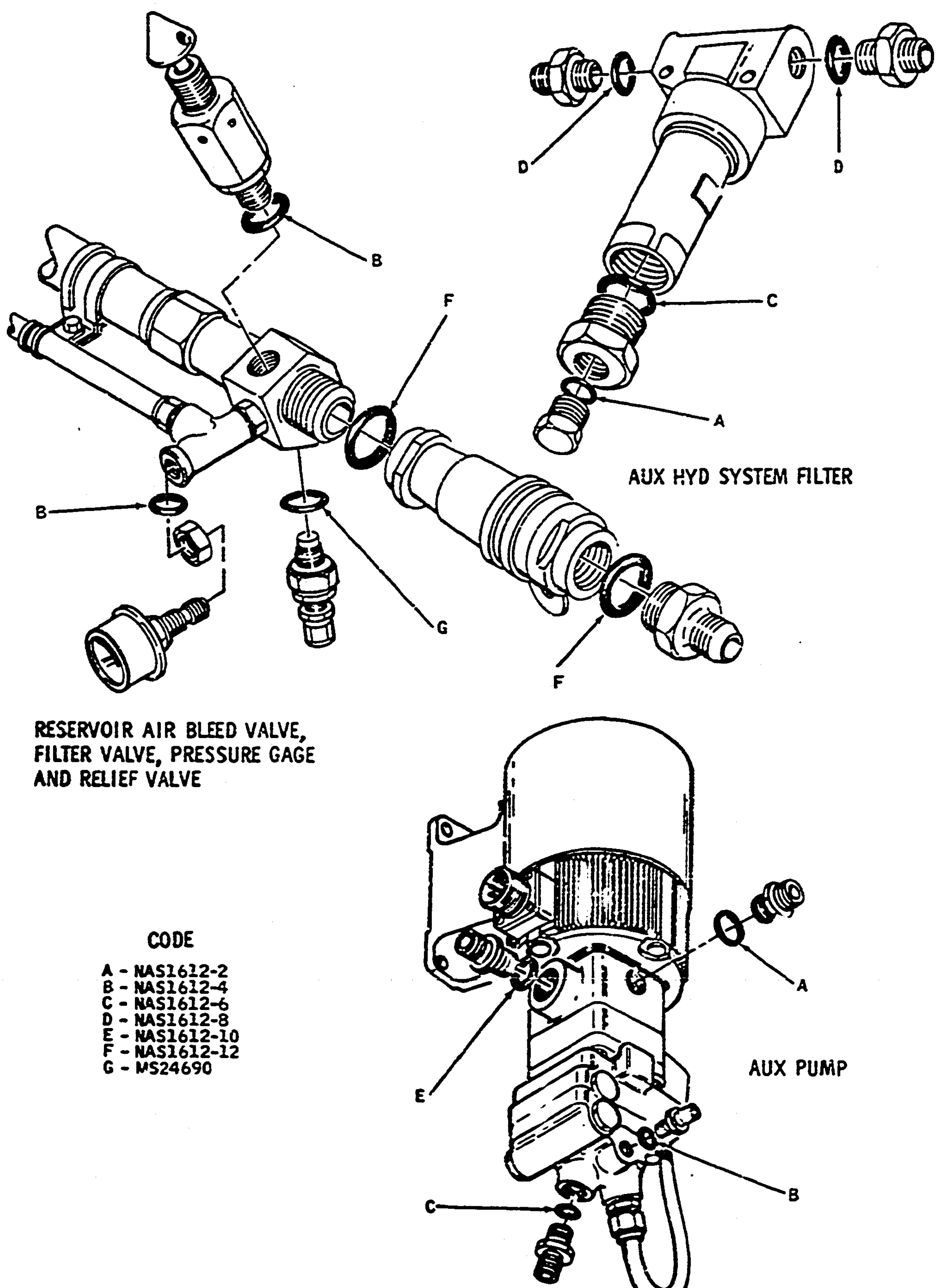
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

HA2-1678A

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 5)

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System with Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System with Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed.

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

<u>CAUTION</u>: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) The thrust reverser system is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under finger nails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Al ys check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Company, or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

(4) The main gear bogie beams should be locked in the trail position at all times, except as noted in maintenance procedural steps.

WARNING: WHEN THE AIRPLANE IS ON WING AND FUSELAGE JACKS, THE MAIN GEAR WHEELS ARE CLEAR OF THE GROUND, AND THE HYDRAULIC POWER SYSTEM IS PRESSURIZED, THE AFT BOGIE AND WHEELS WILL SWING OUTBOARD VERY RAPIDLY IN THE DIRECTION OF NOSEWHEEL TURN IF THE NOSEWHEELS ARE TURNED MORE THAN 40 DEGREES. BOGIE AND MAIN GEAR AFT WHEELS WILL RETURN TO TRAIL POSITION JUST AS RAPIDLY WHEN THE NOSEWHEELS ARE RETURNED TO NEUTRAL POSITION. THIS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING NEAR THE WHEELS.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

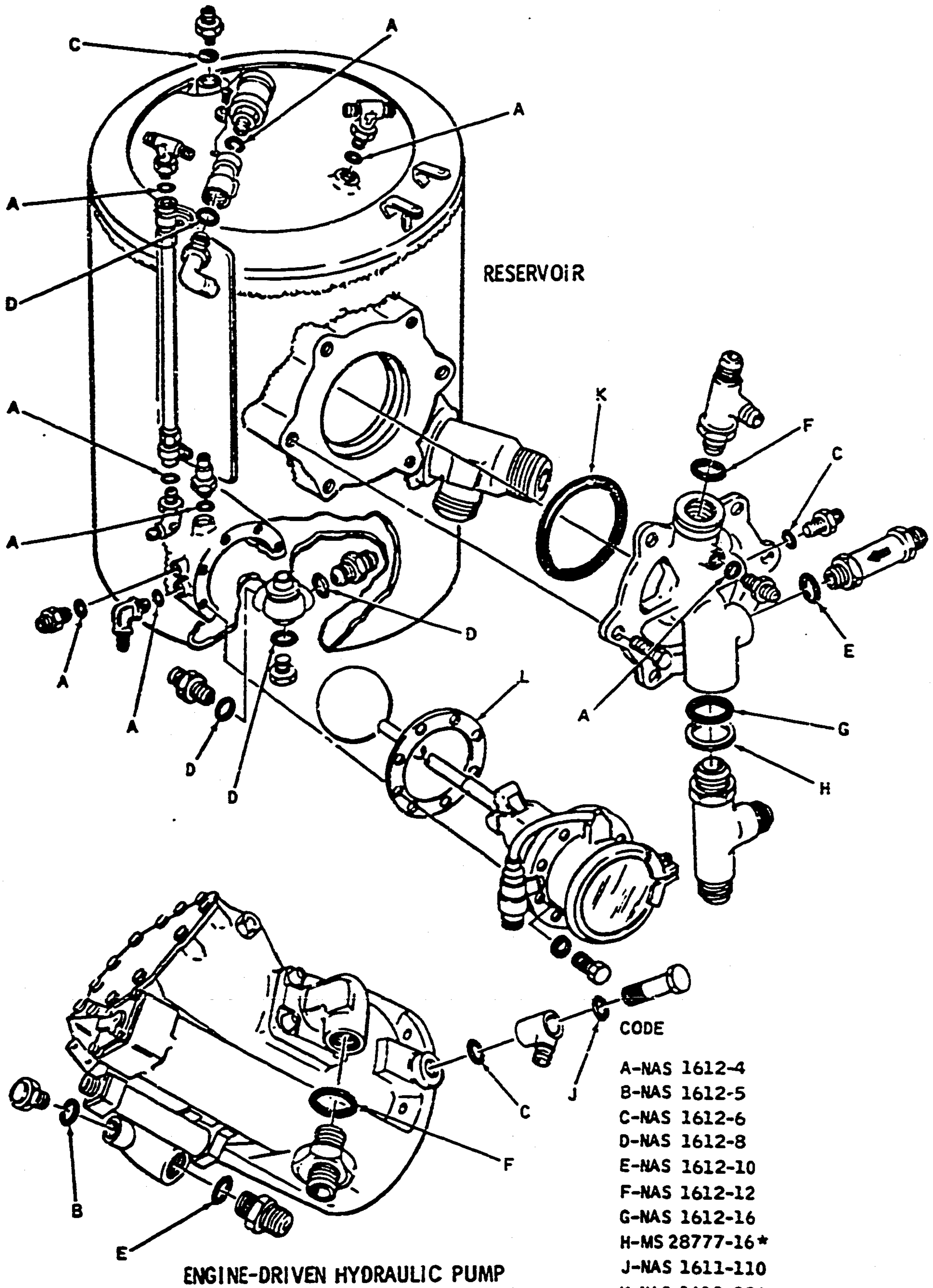
(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

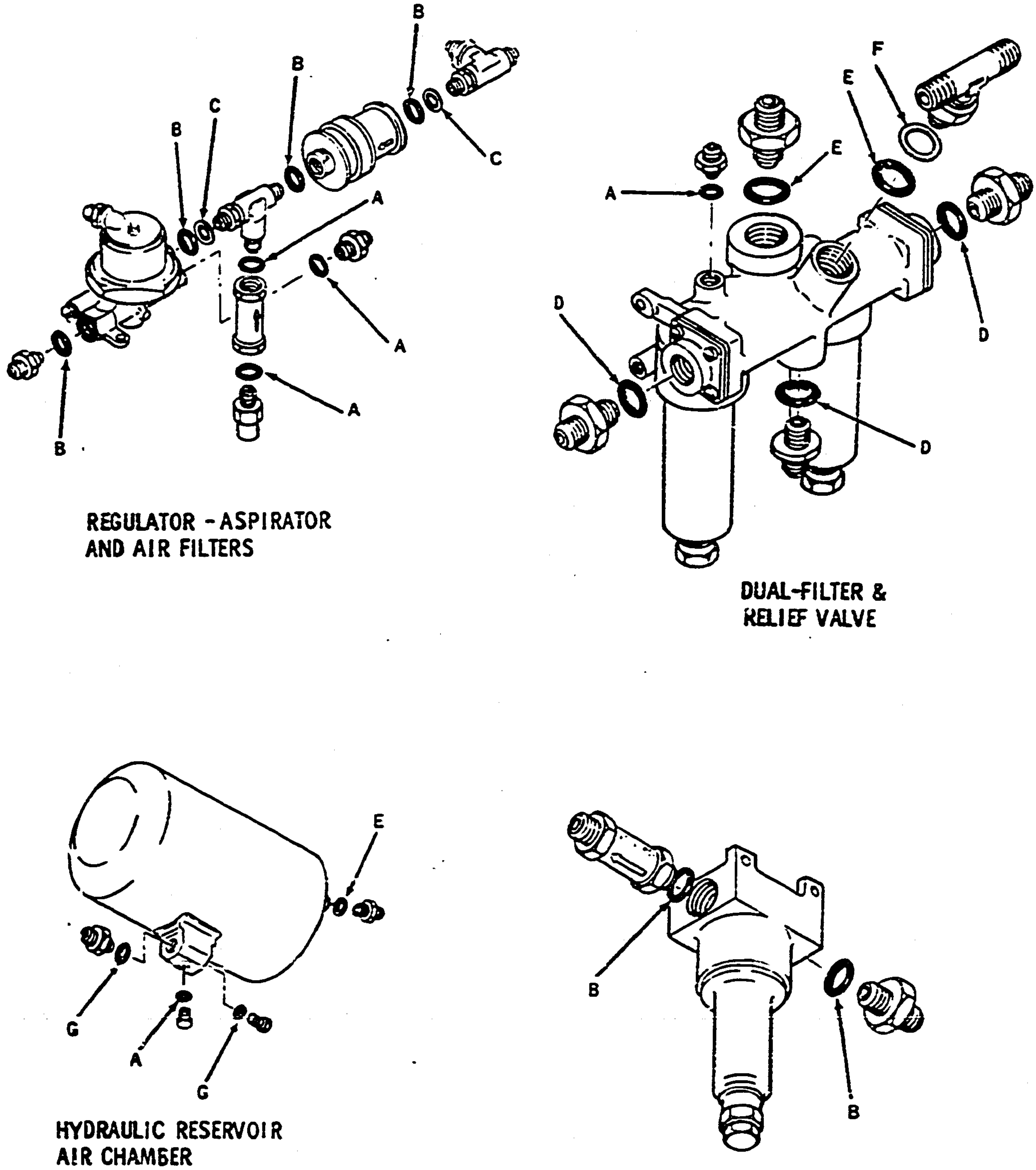
(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 1)



CODE:
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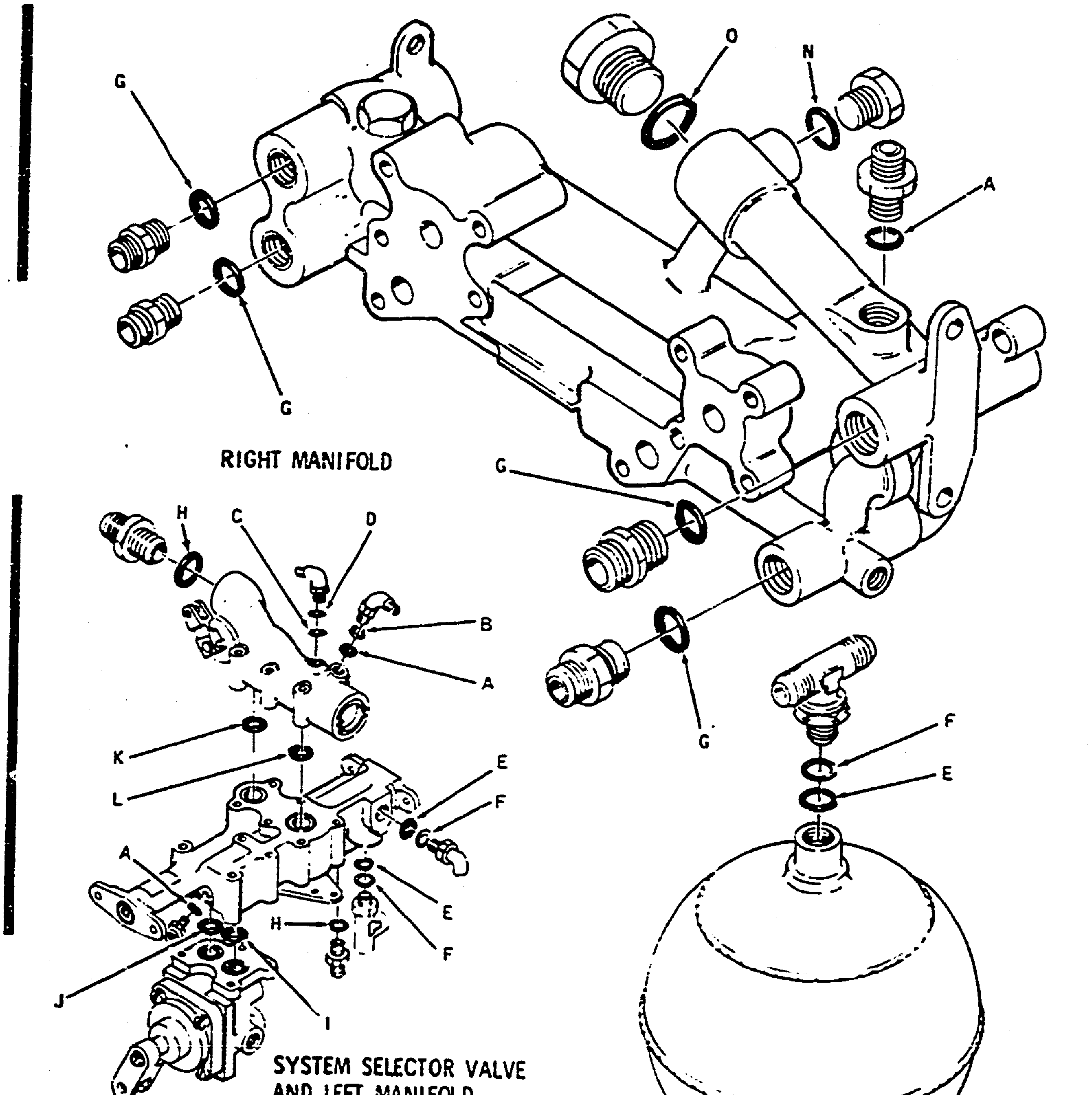
B - NAS1612-6
C - MS28777-6*
D - NAS1612-10
E - NAS1612-12
F - MS28777-12*
G - NAS1612-16
* - BACKUP RING

HA2-1101A

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 2)



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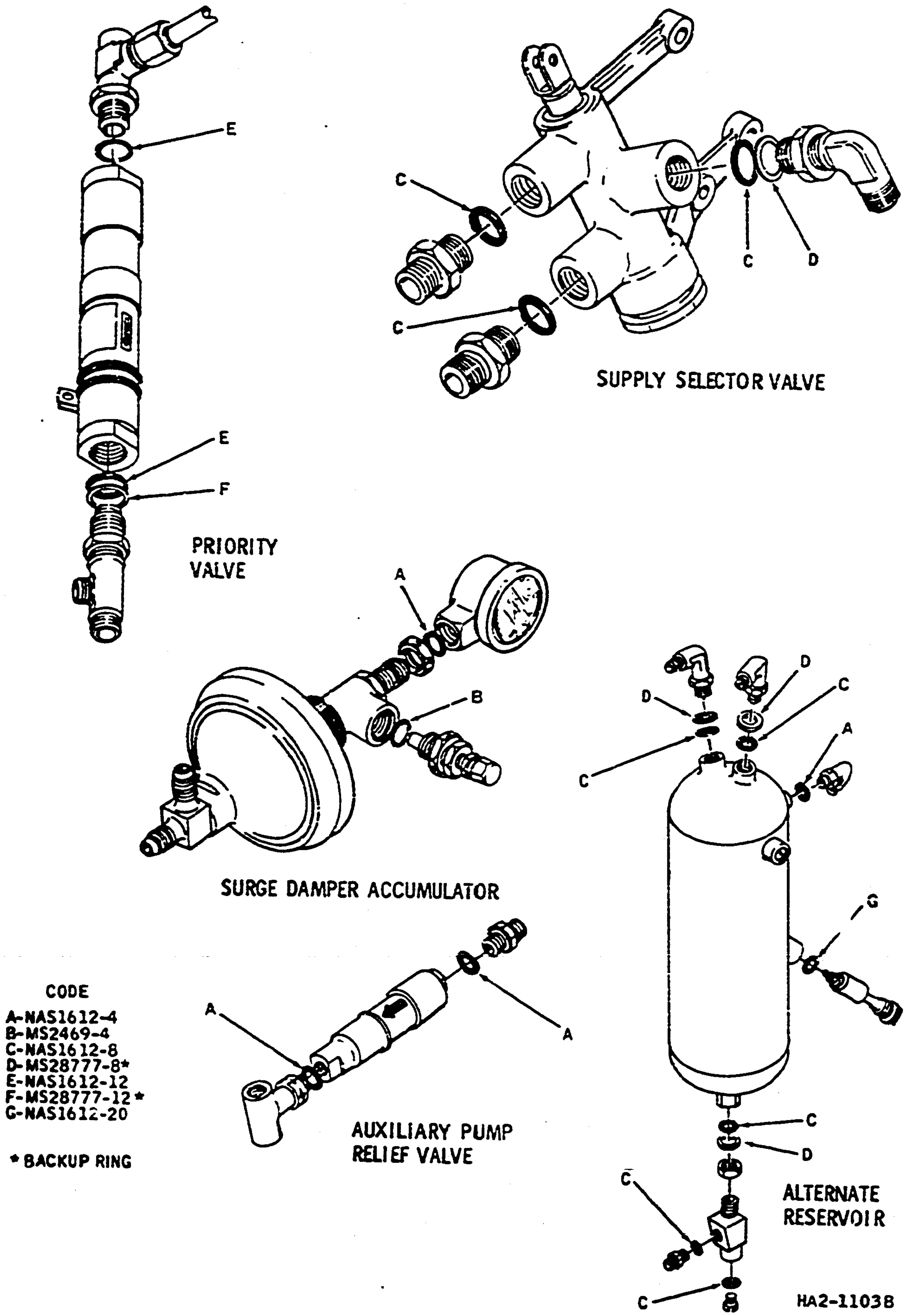
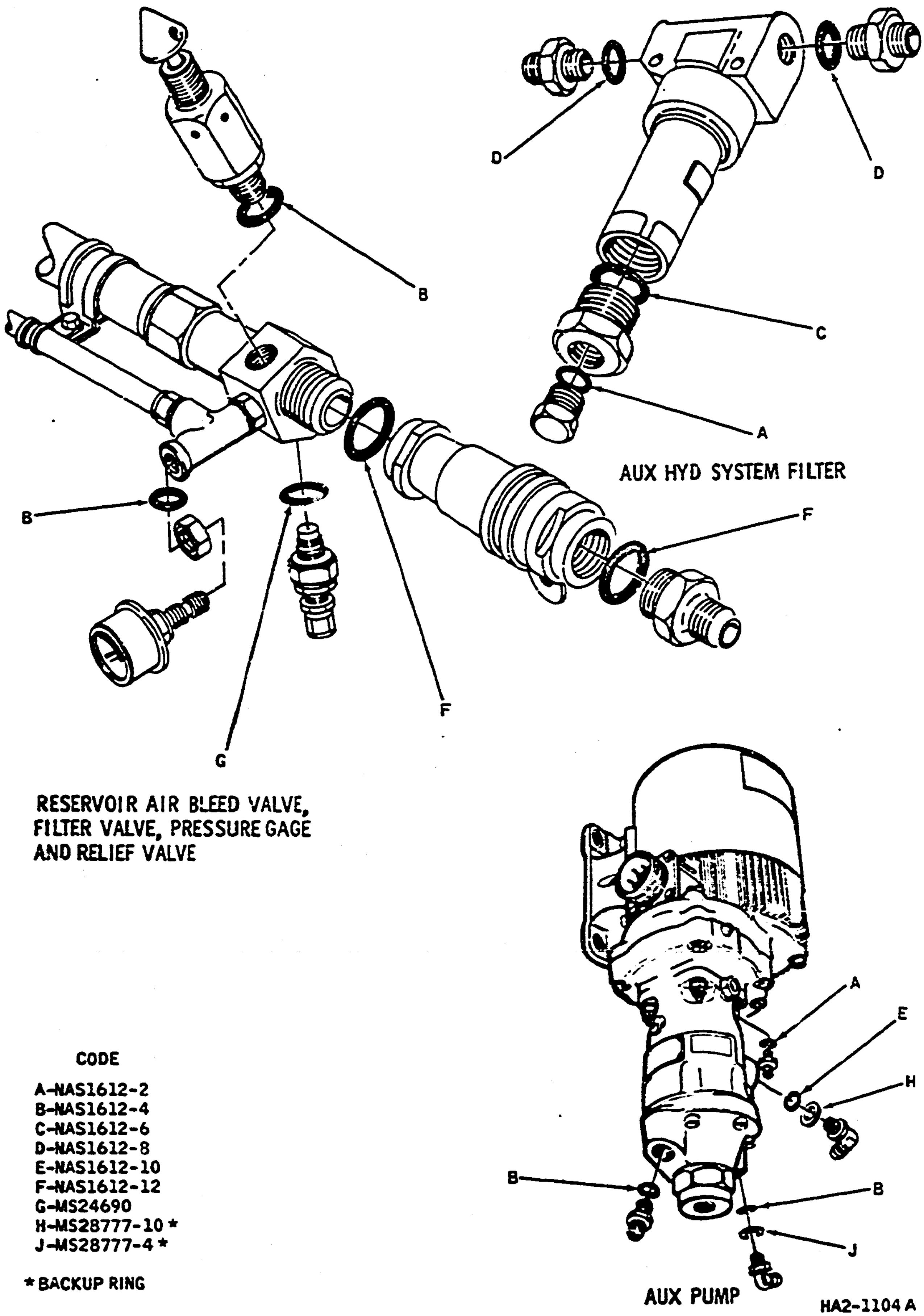
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8
G-NAS1612-10
H-NAS1612-12
I-NAS1611-111
J-NAS1611-113
K-NAS1611-213
L-NAS1611-217
M-MS-24690
N-NAS1612-6
O-NAS1611-210
*-BACKUP RING

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 4)



CODE

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B-NAS1612-4
C-NAS1612-6
D-NAS1612-8
E-NAS1612-10
F-NAS1612-12
G-MS24690
H-MS28777-10 *
J-MS28777-4 *

* BACKUP RING

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 5)

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System With Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System With Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

<u>WARNING:</u> BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. <u>Pressurize/Depressurize Hydraulic Reservoir</u>

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates

determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal)

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position

(c) Manual main gear door valve open

(d) Landing gear down and locked

(e) Wing flaps up

(f) Accumulators properly charged

(g) Aileron shutoff valve off

(h) Rudder shutoff valve off

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1). Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.)

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

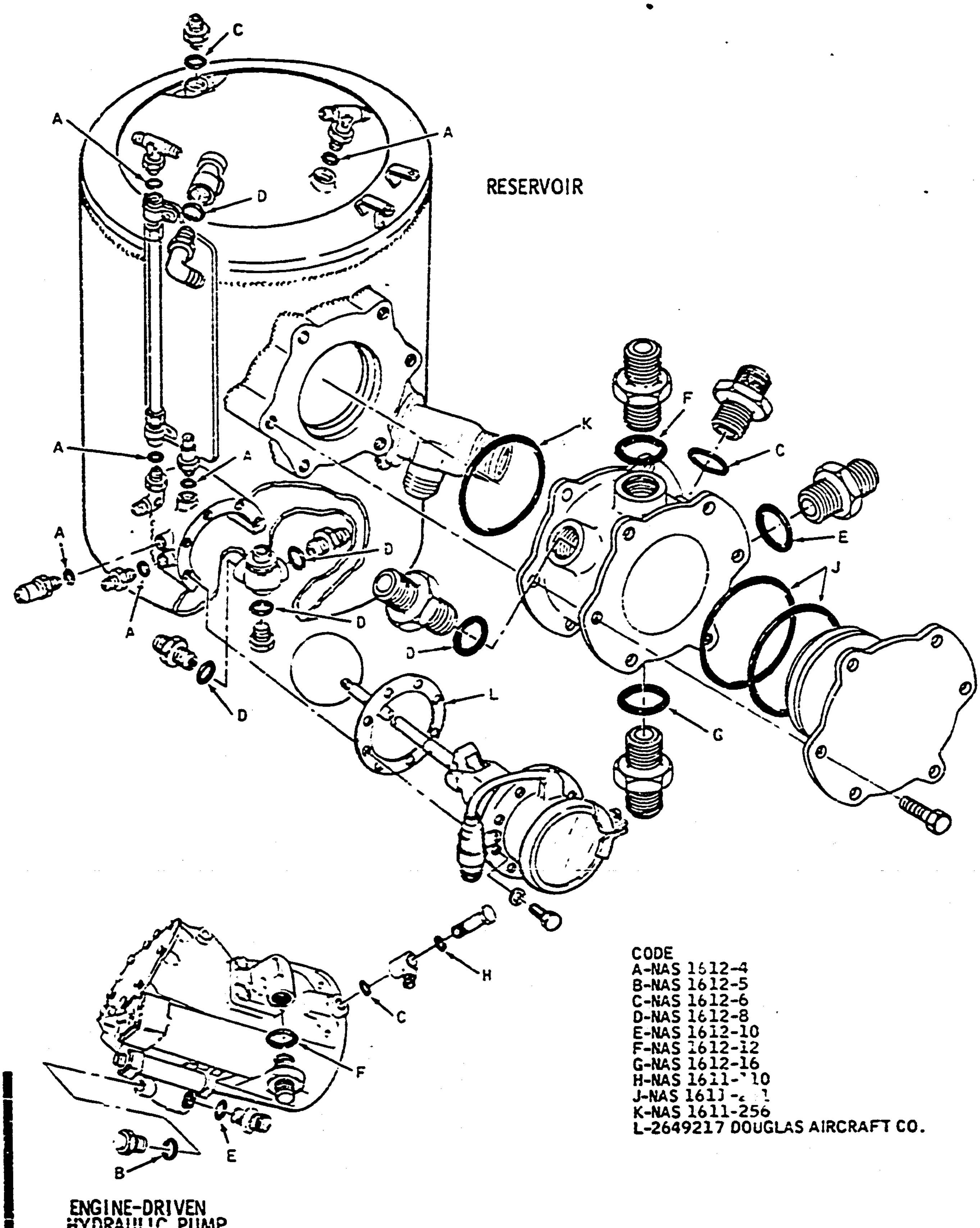
(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.



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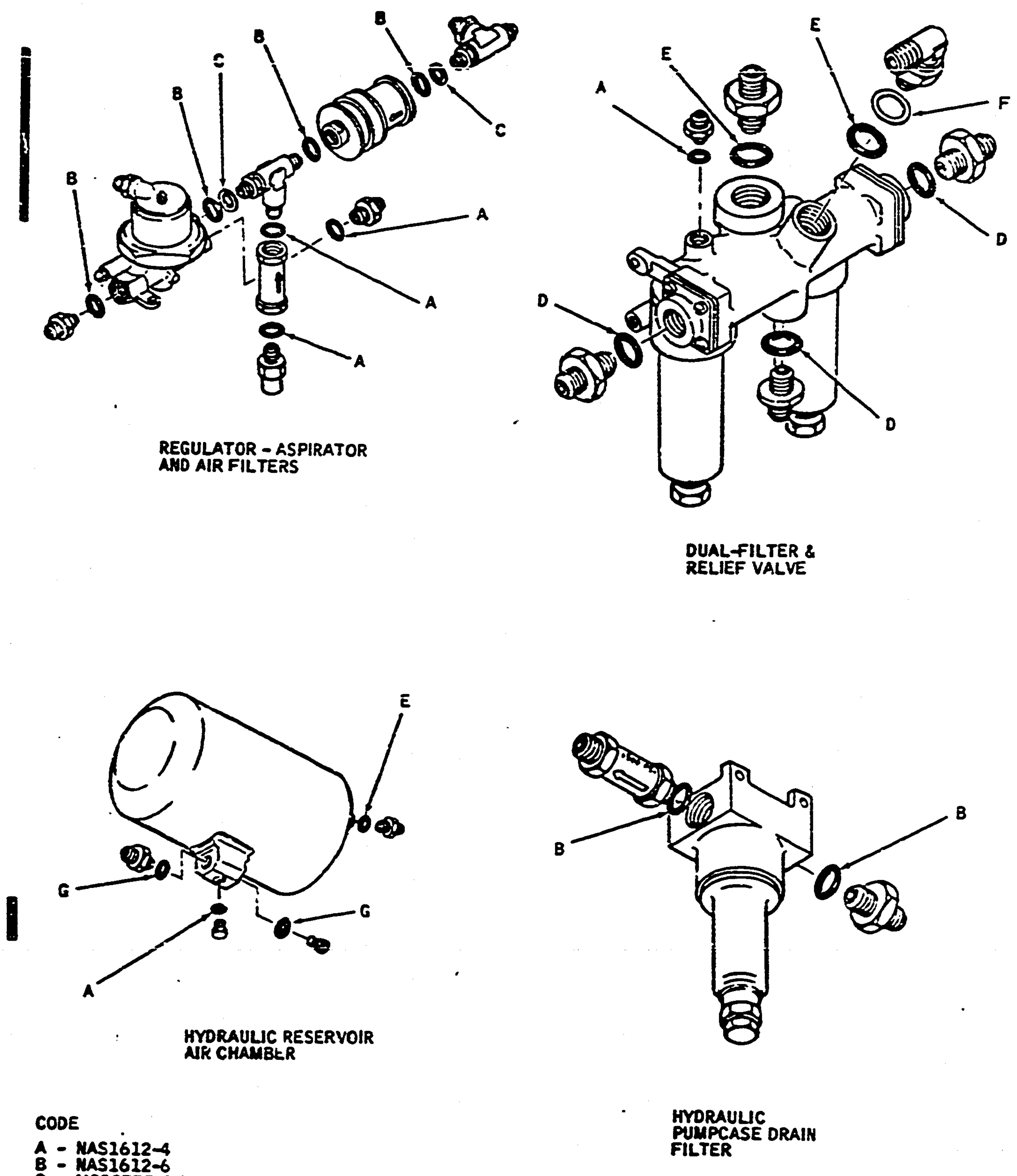
B-NAS 1612-5
C-NAS 1612-6
D-NAS 1612-8
E-NAS 1612-10
F-NAS 1612-12
G-NAS 1612-16
H-NAS 1611-[illegible]10
J-NAS 1611-[illegible]
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

HA2-2139B

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



CODE

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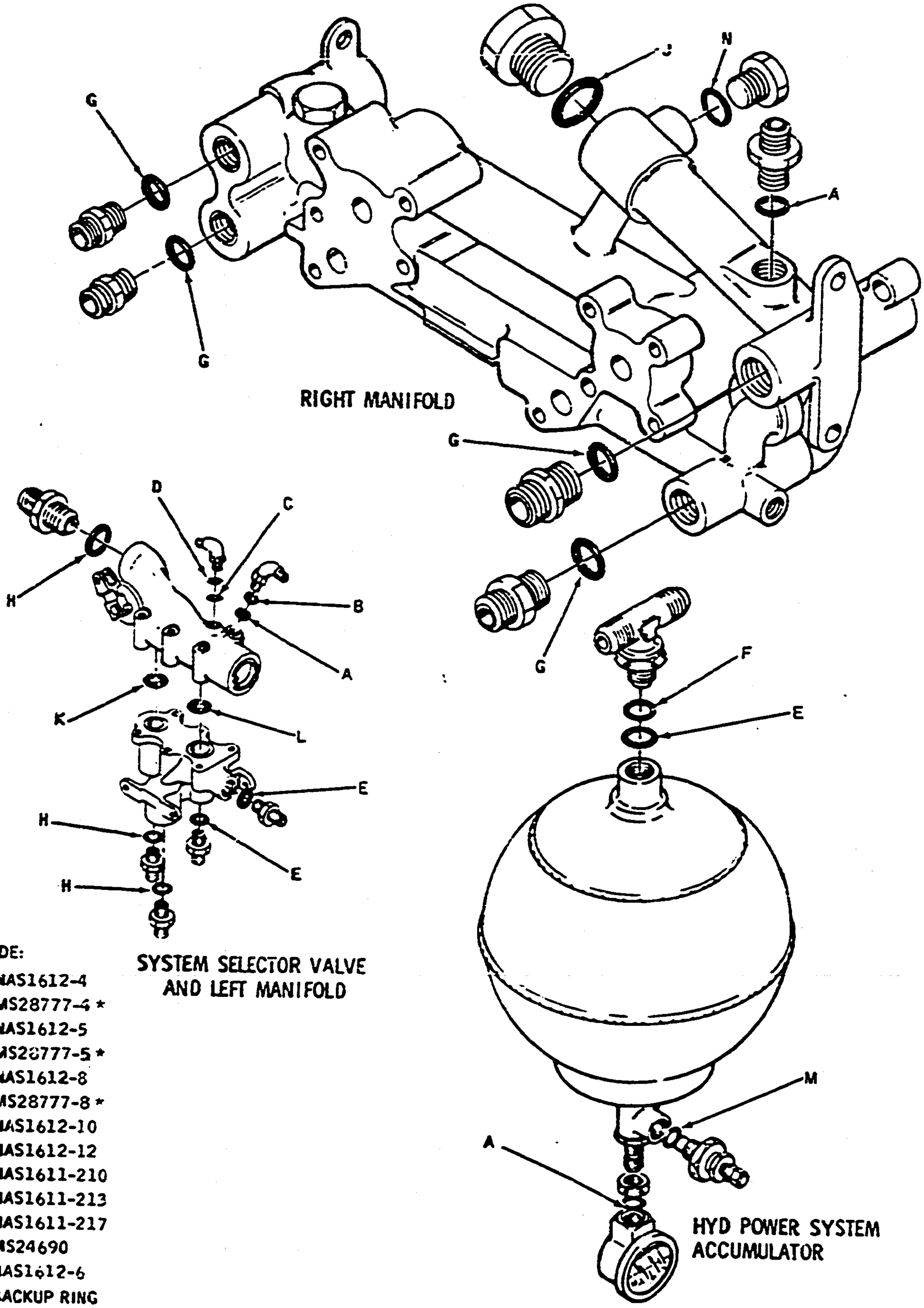
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16

* - BACKUP RING

HA2-3415B

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 2)



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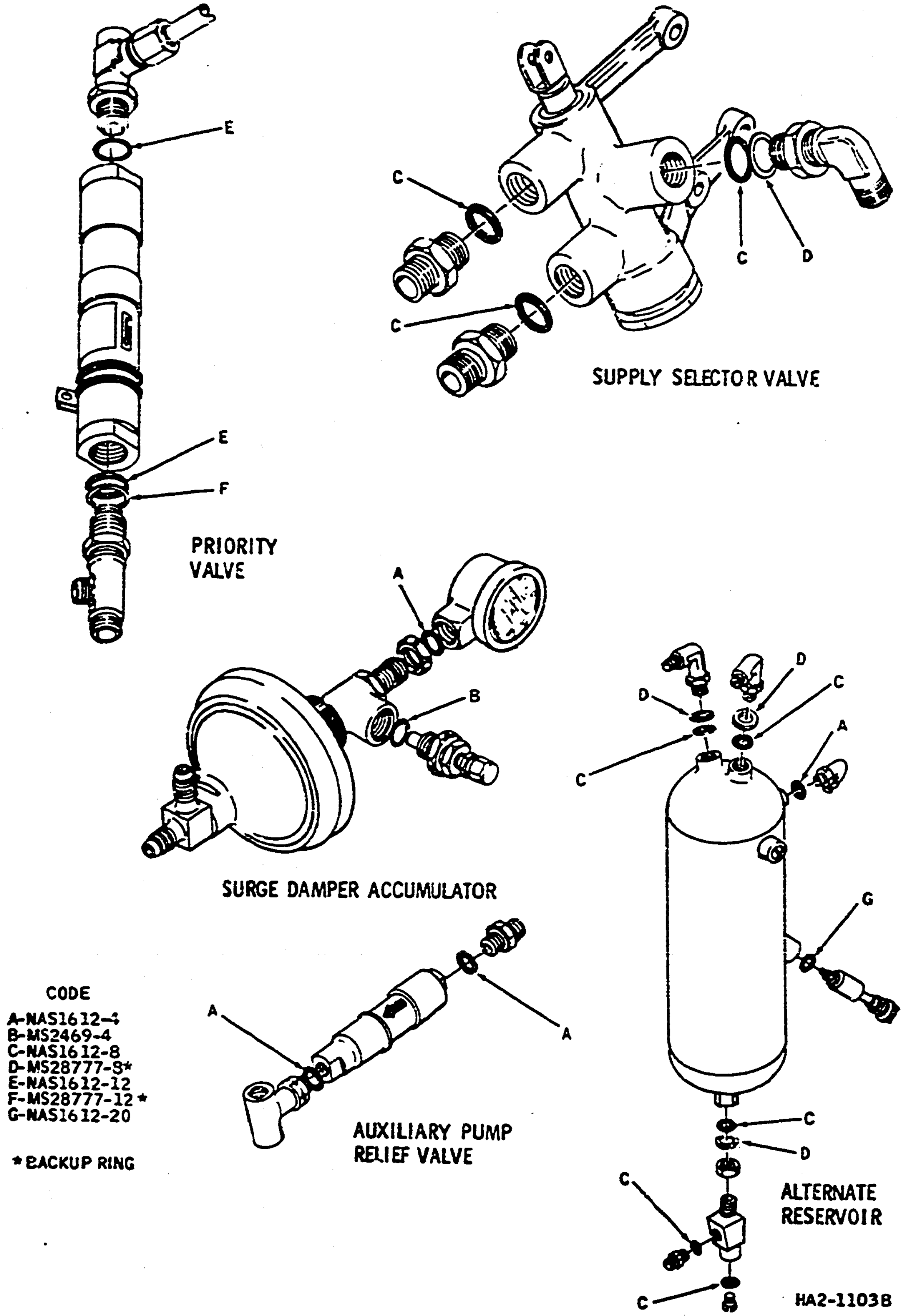
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 4)

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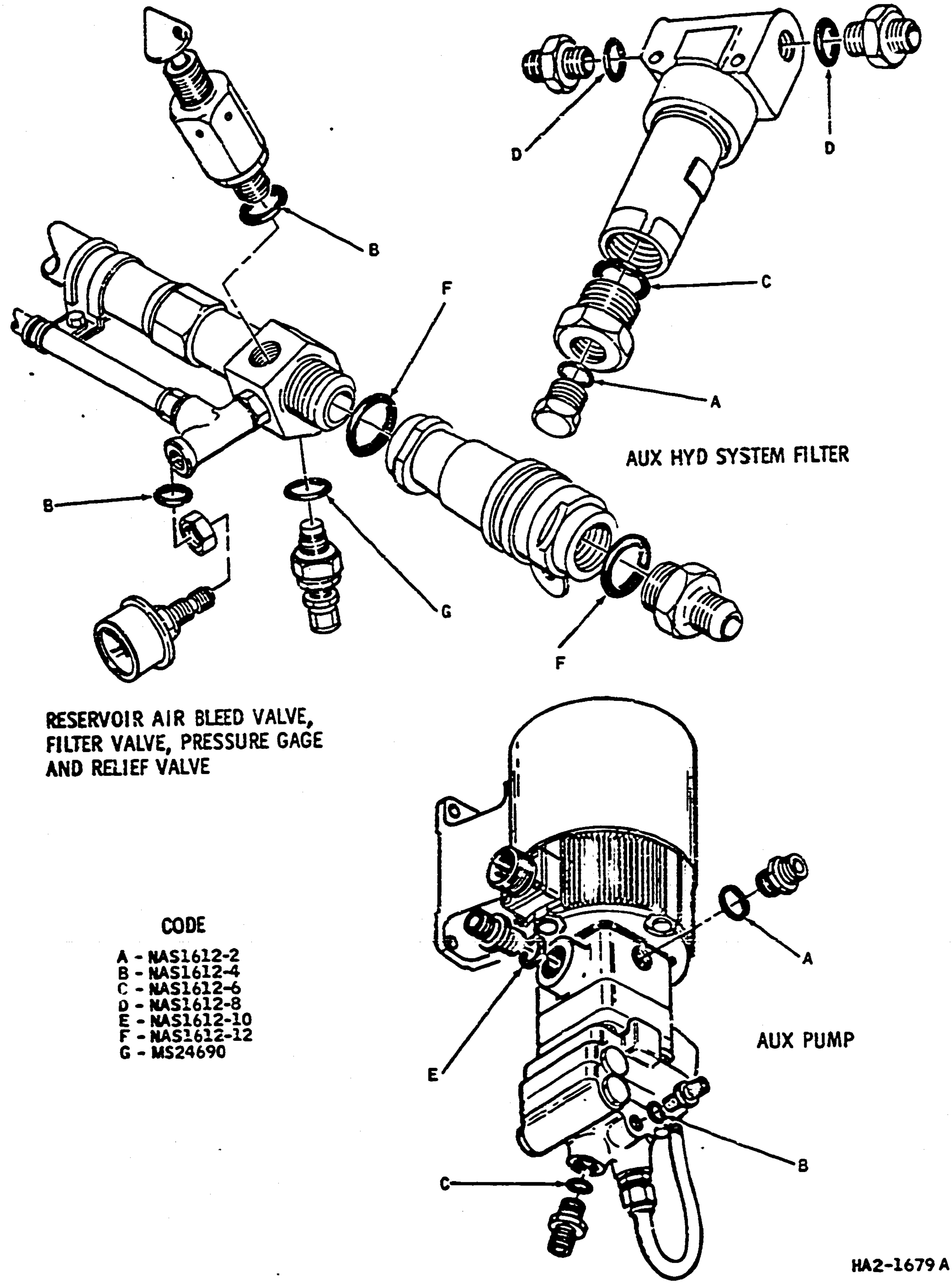
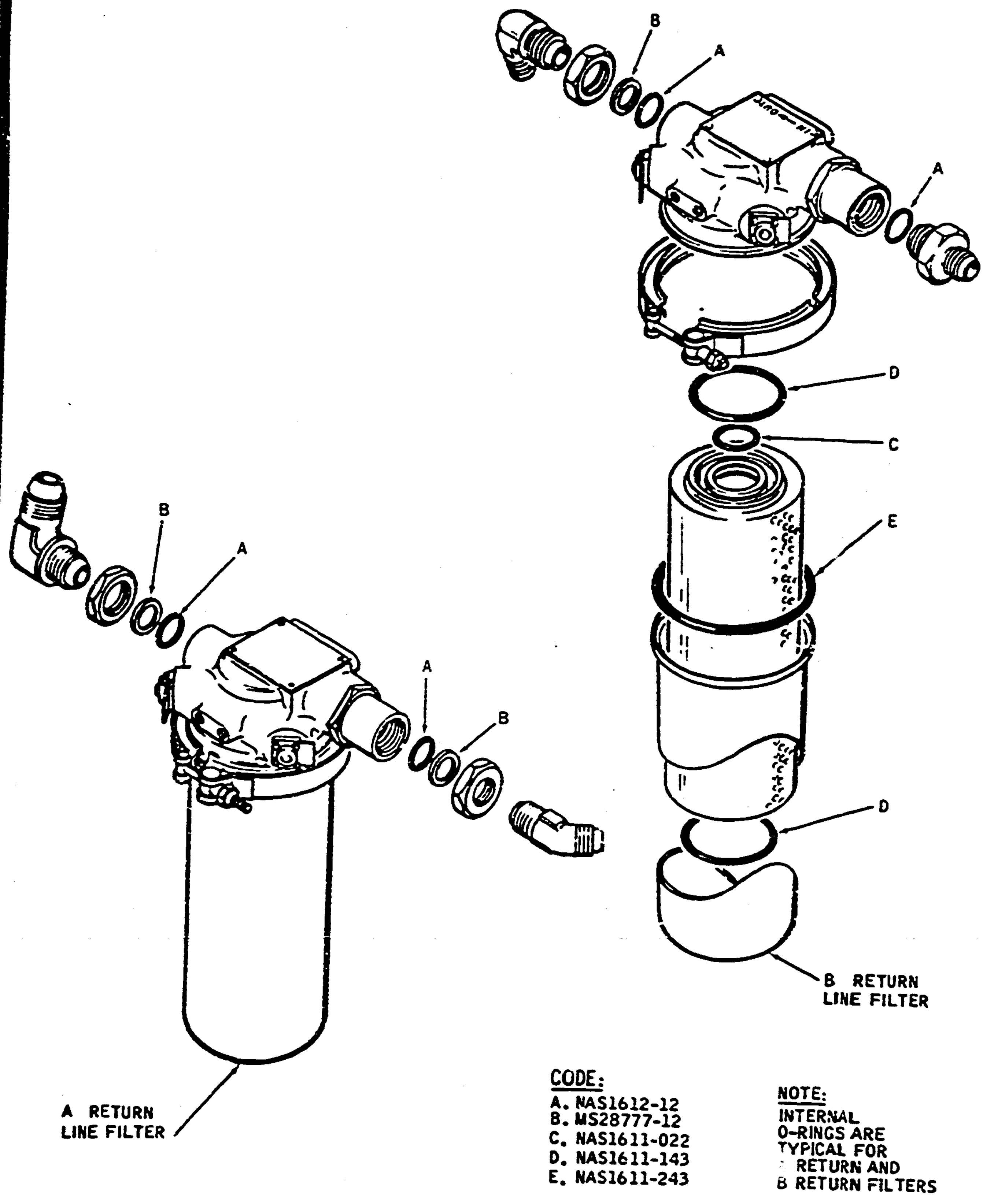


Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 5)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 6)

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System With External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System With Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System With Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

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(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

<u>NOTE</u>: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

<u>CAUTION</u>: THE AIR INFLATION VALVE IS A STANDARD 'AN' VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has beld off and pressure gage reads zero.

4. <u>Drain Hydraulic System Reservoir</u>

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed.

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for

the brake system, with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±10) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) The thrust reverser system is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol, remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Company, or clean Skyrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

(4) The main gear bogie beams should be locked in the trail position at all times, except as noted in maintenance procedural steps.

WARNING: WHEN THE AIRPLANE IS ON WING AND FUSELAGE JACKS, THE MAIN GEAR WHEELS ARE CLEAR OF THE GROUND, AND THE HYDRAULIC POWER SYSTEM IS PRESSURIZED, THE AFT BOGIE AND WHEELS WILL SWING OUTBOARD VERY RAPIDLY IN THE DIRECTION OF NOSWWHEEL TURN IF THE NOSEWHEELS ARE TURNED MORE THAN 40 DEGREES. BOGIE AND MAIN GEAR AFT WHEELS WILL RETURN TO TRAIL POSITION JUST AS RAPIDLY WHEN THE NOSEWHEELS ARE RETURNED TO NEUTRAL POSITION. THIS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING NEAR THE WHEELS.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System With External Hydraulic Source Pressure

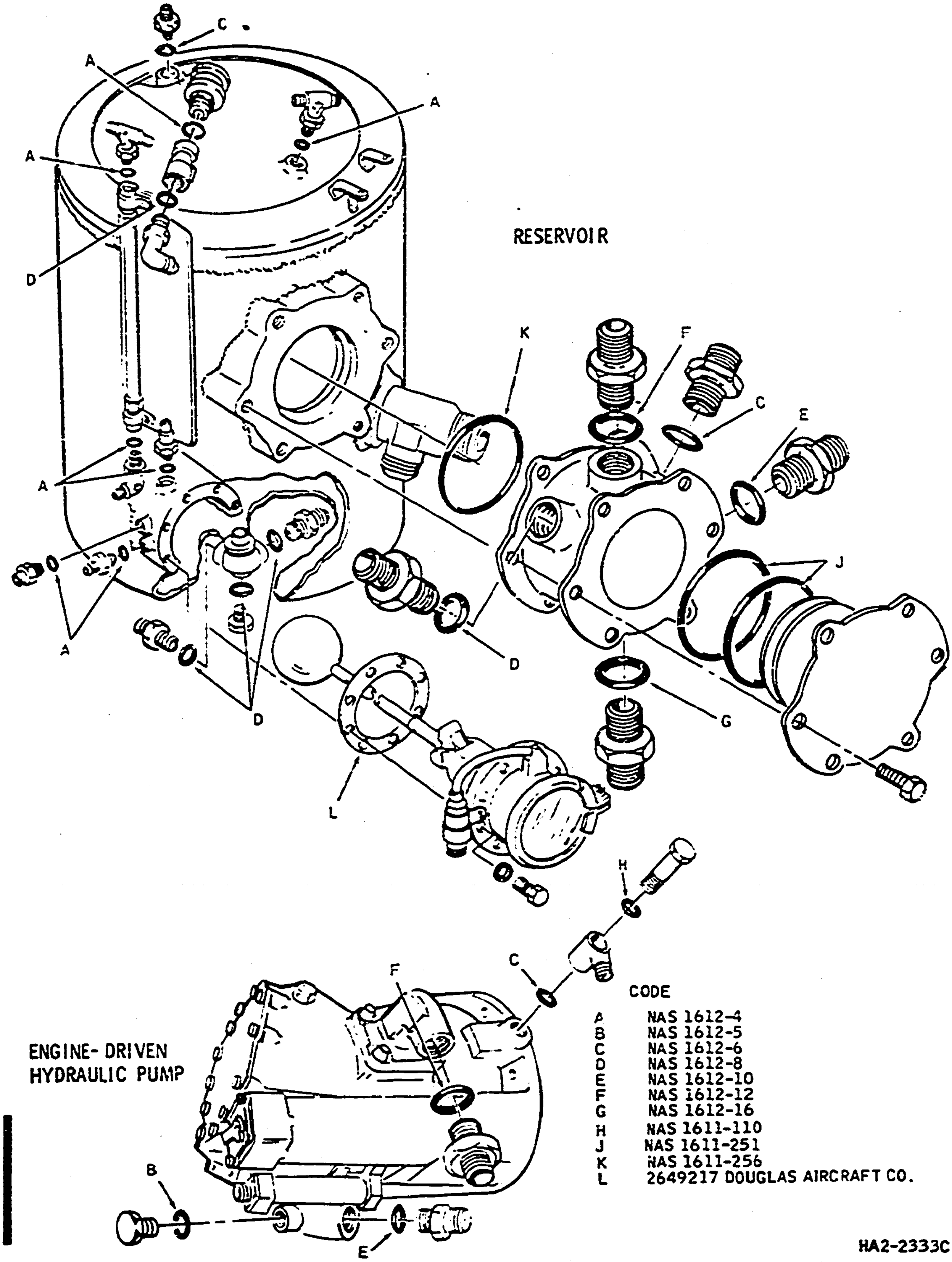
(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 200 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

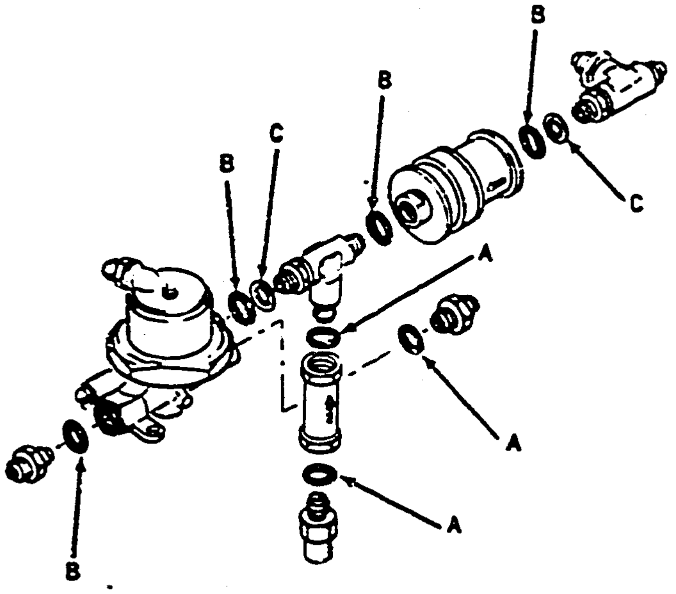
(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

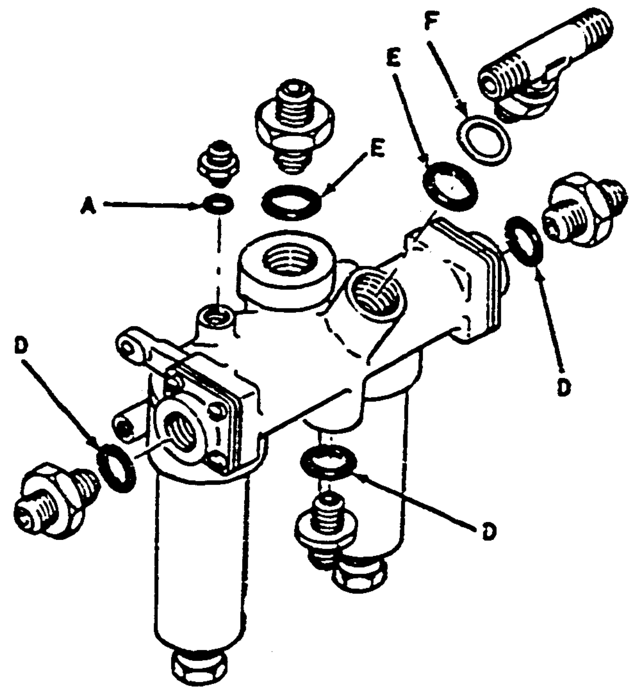
(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.



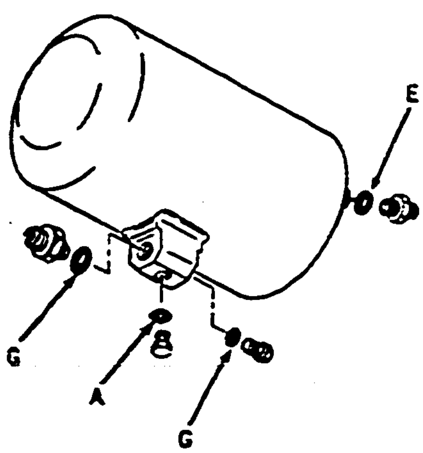
Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



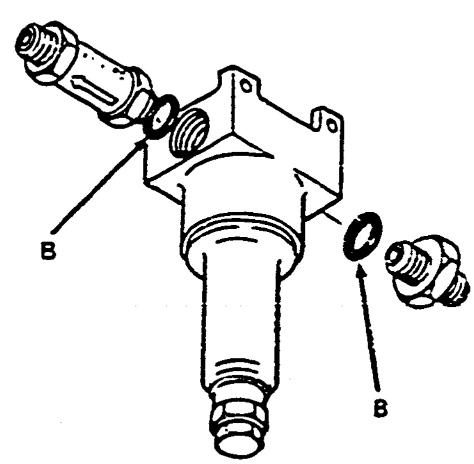
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



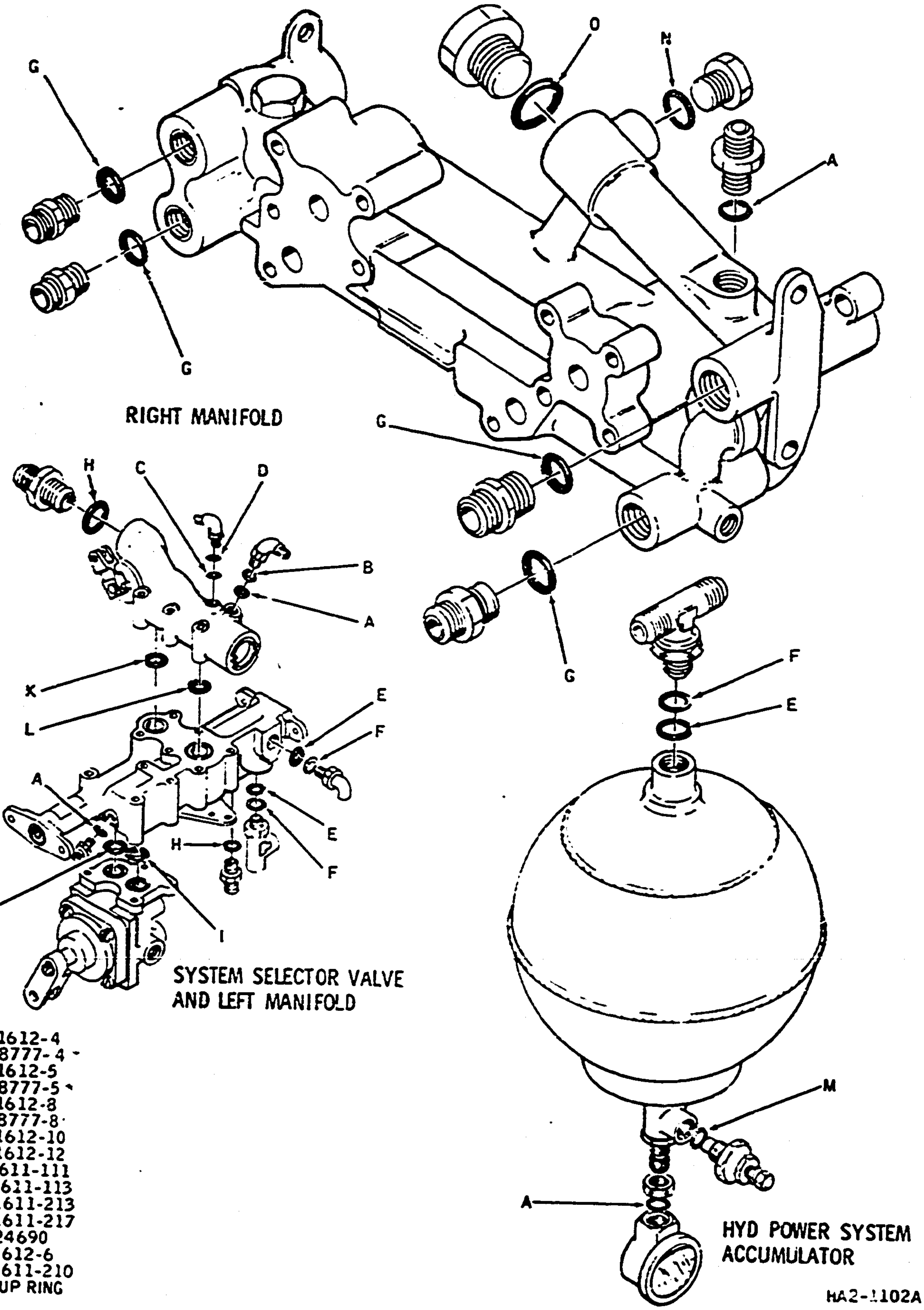
HYDRAULIC
PUMPCASE DRAIN
FILTER

CODE:

A - NAS1612-4
B - NAS1612-6
C - MS28777-6*
D - NAS1612-10
E - NAS1612-12
F - MS28777-12*
G - NAS1612-16
* - BACKUP RING

HA2-1101A

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 2)



CODE:
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B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
I-NAS1611-111
J-NAS1611-113
K-NAS1611-213
L-NAS1611-217
M-MS-24690
N-NAS1612-6
O-NAS1611-210
*-BACKUP RING

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 3)

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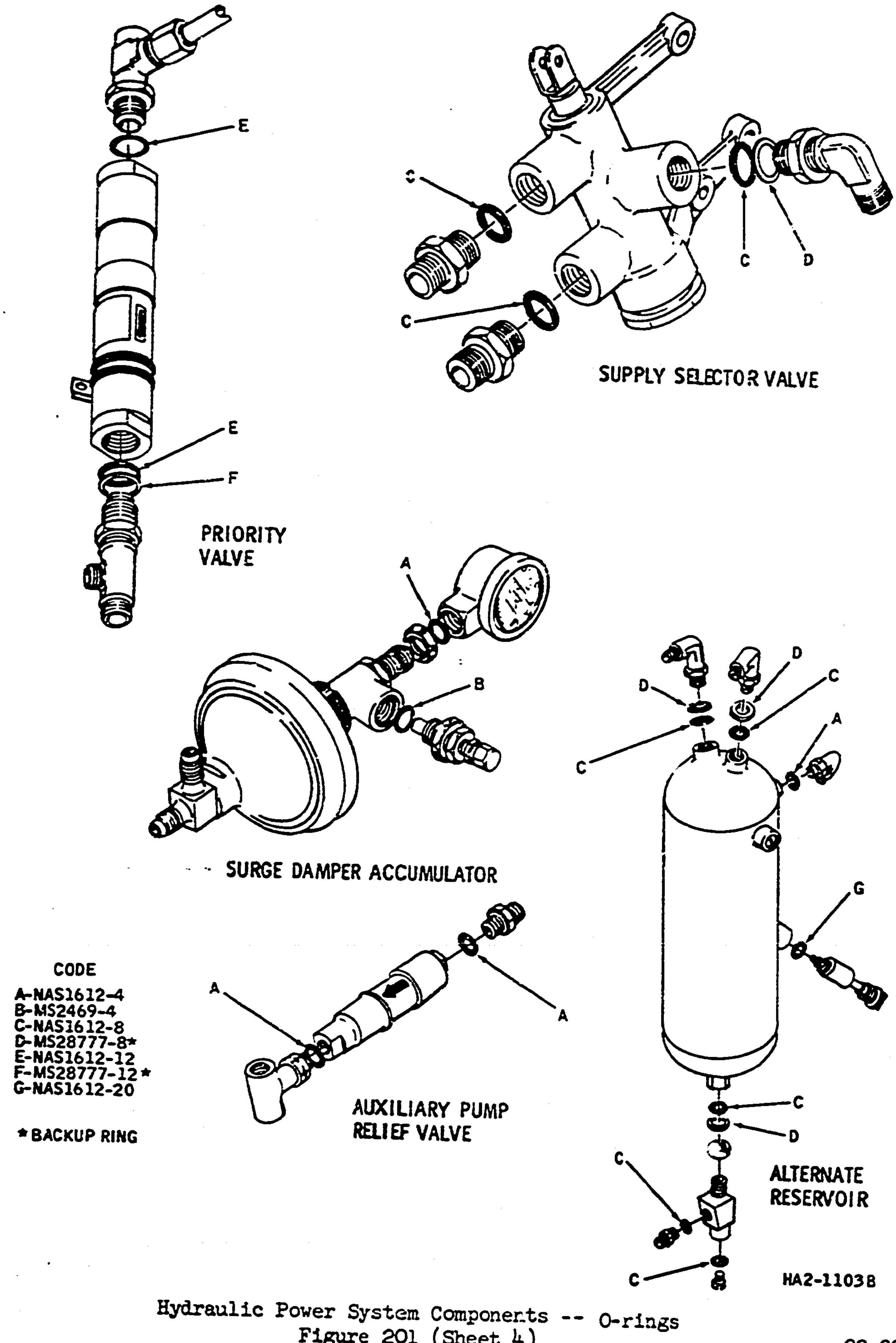
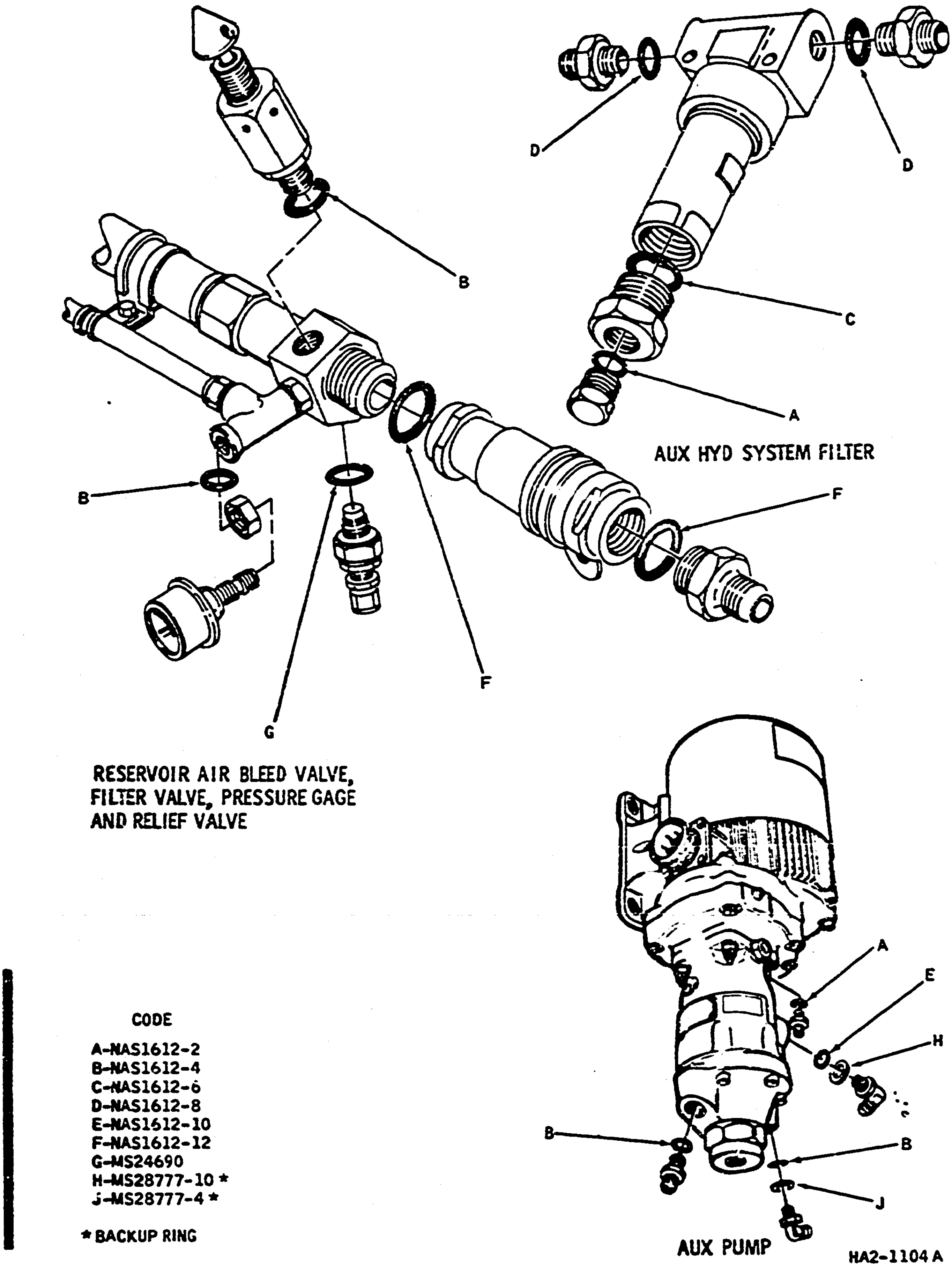


Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 5)

Printed in U.S.A.

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

<u>WARNING</u>: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System With Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

<u>WARNING</u>: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

<u>CAUTION</u>: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System With Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are

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mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system

with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal)

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position

(c) Manual main gear door valve open

(d) Landing gear down and locked

(e) Wing flaps up

(f) Accumulators properly charged

(g) Aileron shutoff valve off

(h) Rudder shut ff valve off

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff

valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

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GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

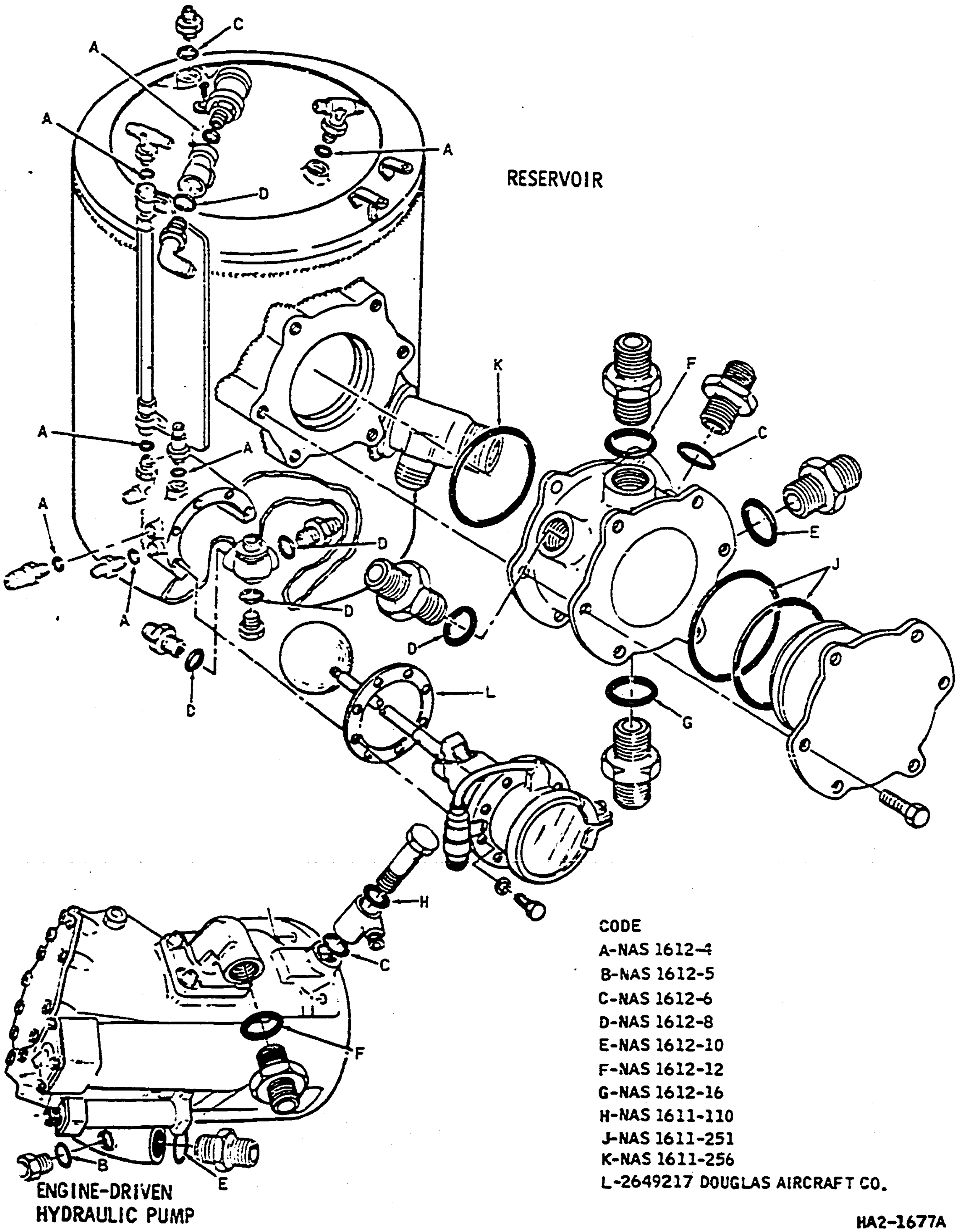
(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

D. Hydraulic Power System O-Rings

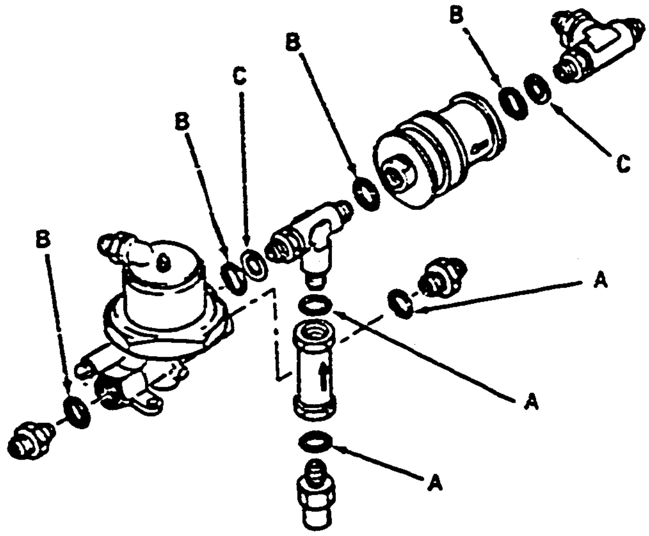
(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.



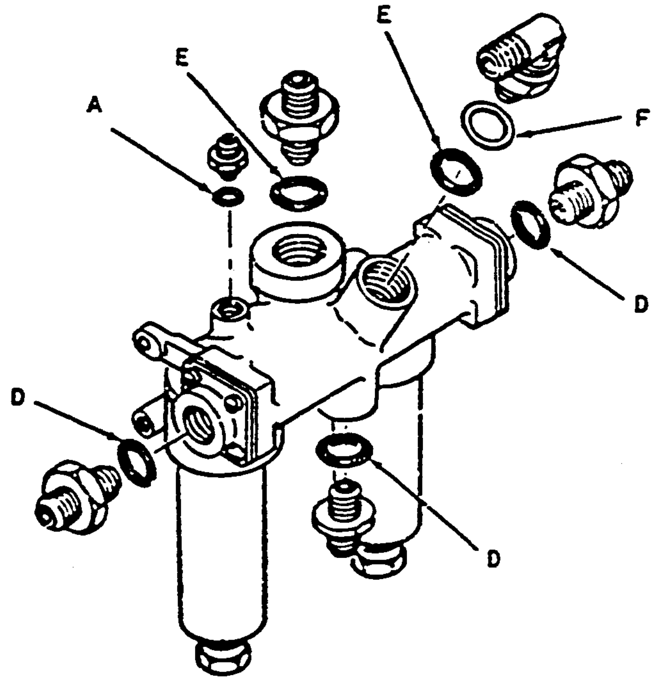
CODE
A-NAS 1612-4
B-NAS 1612-5
C-NAS 1612-6
D-NAS 1612-8
E-NAS 1612-10
F-NAS 1612-12
G-NAS 1612-16
H-NAS 1611-110
J-NAS 1611-251
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

HA2-1677A

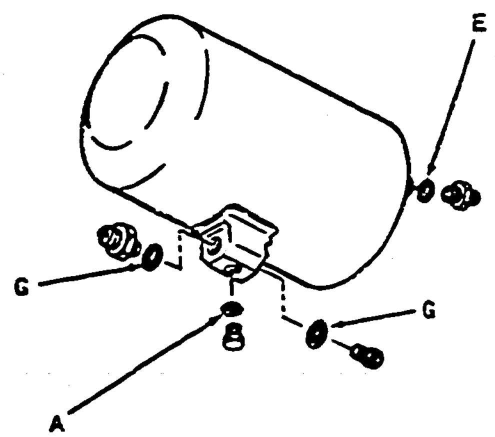
Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



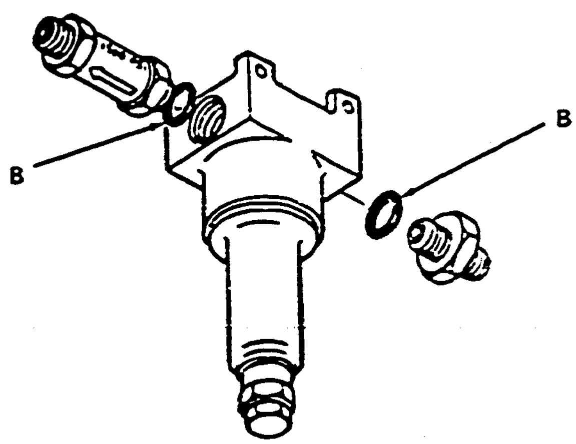
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER

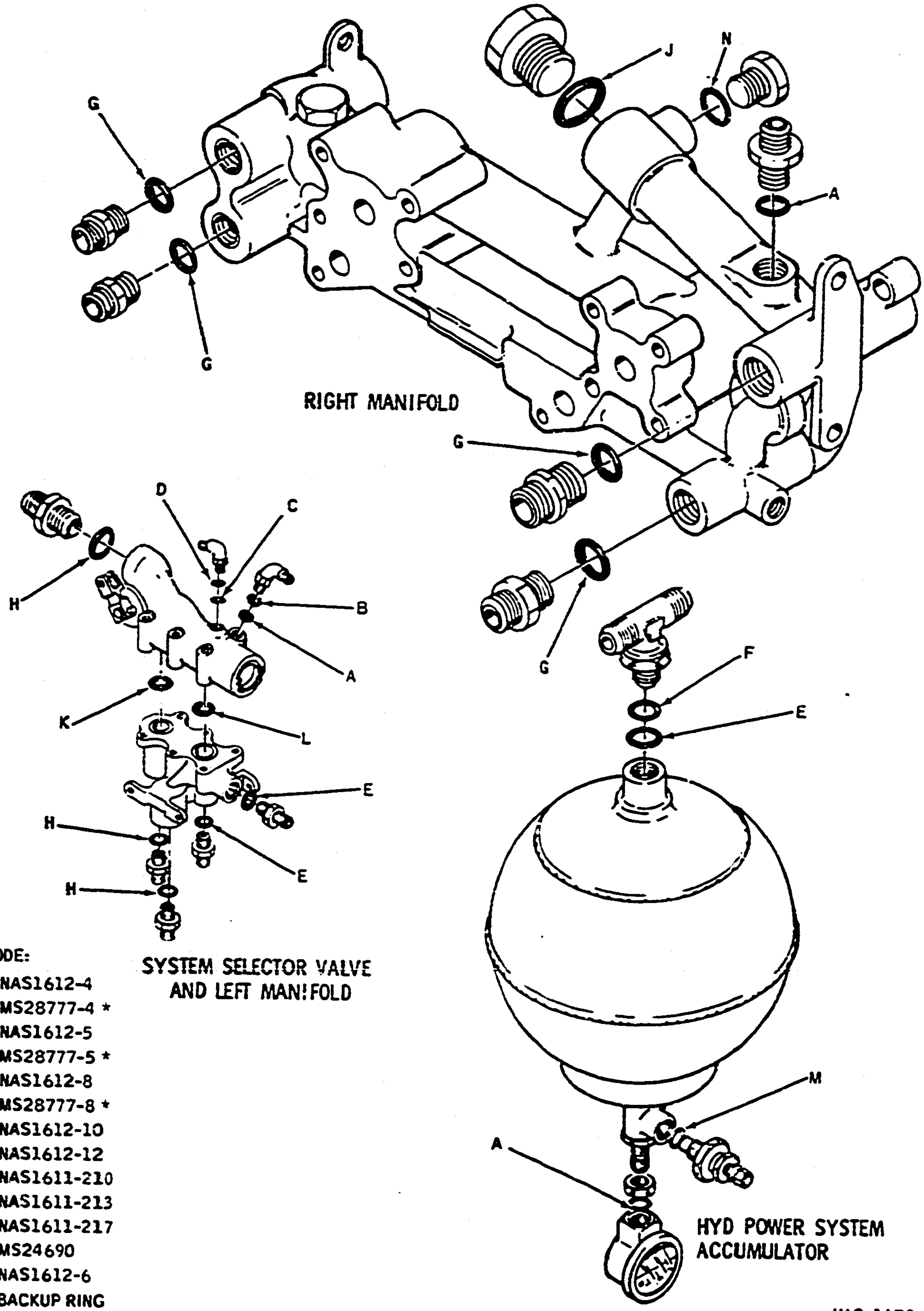


HYDRAULIC
PUMPCASE DRAIN
FILTER

CODE
A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16
* - BACKUP RING

HA2-3415B

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 2)



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C-NAS1612-5
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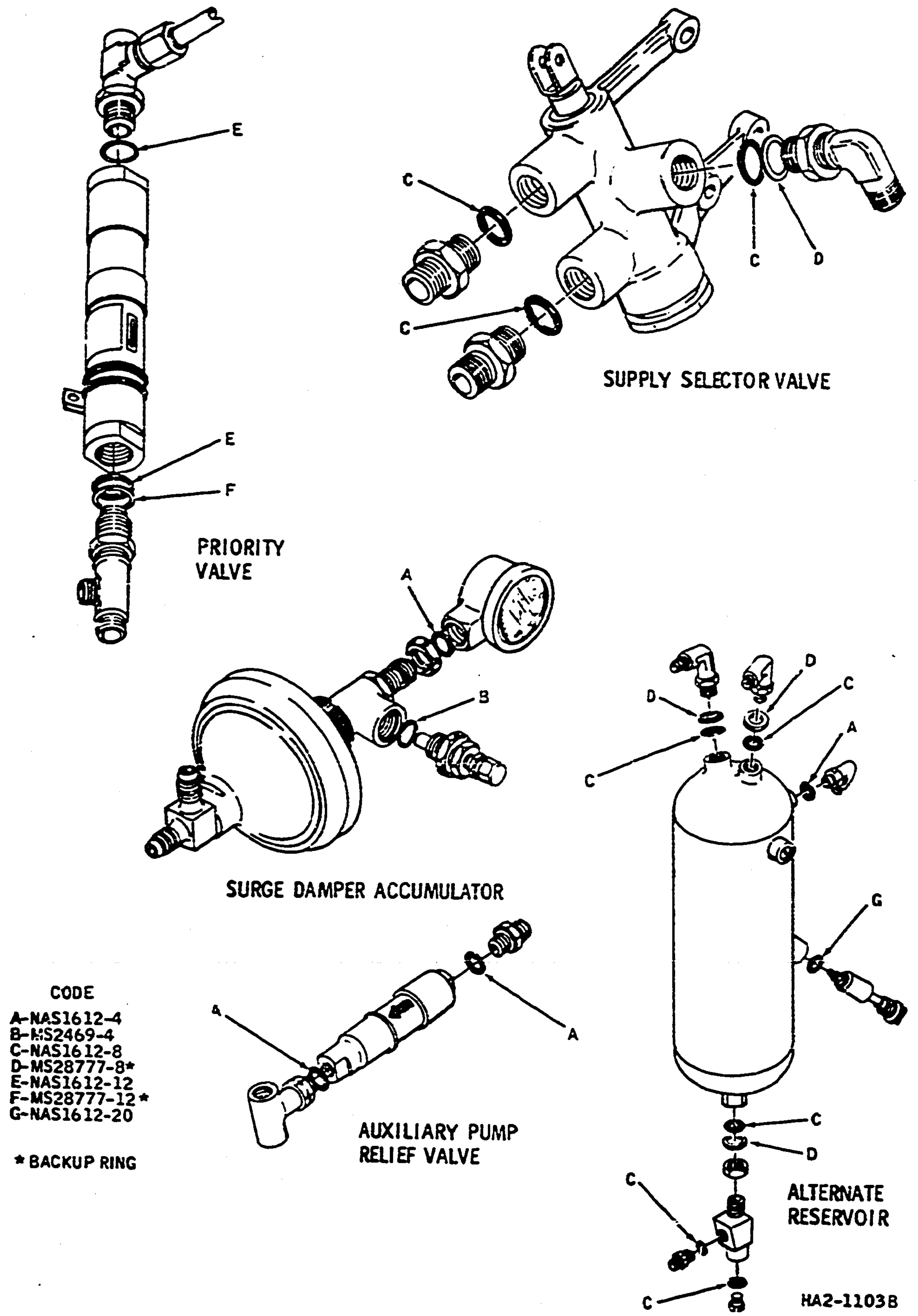
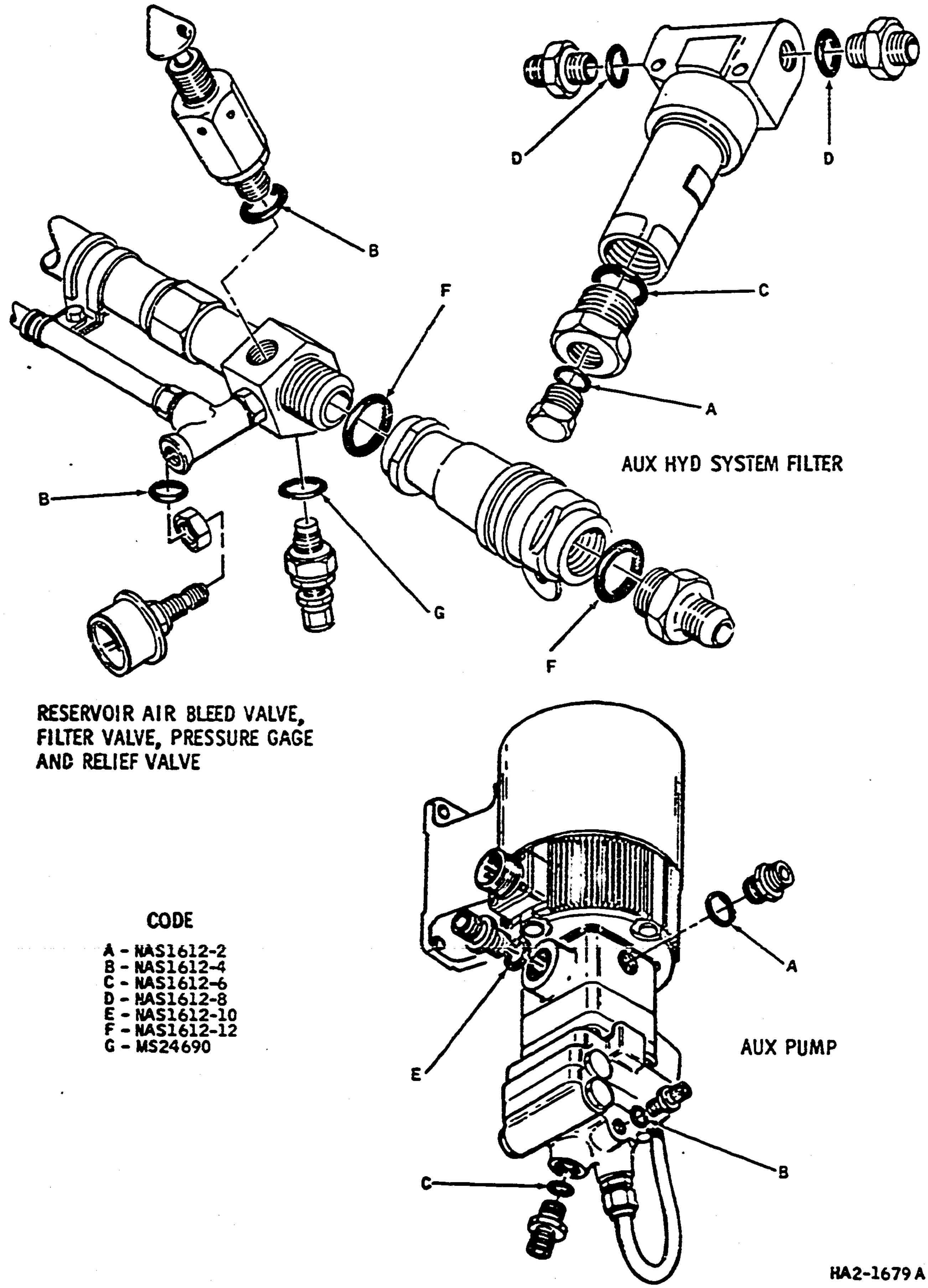
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- C-rings
Figure 201 (Sheet 5)

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System With External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System With Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System With Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the

regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button, hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed.

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(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system, with the parking brake off, indicates either a faulty

brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

<u>CAUTION</u>: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem..

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) The thrust reverser system is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under finger nails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Company, or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

(4) The main gear bogie beams should be locked in the trail position at all times, except as noted in maintenance procedural steps.

WARNING: WHEN THE AIRPLANE IS ON WING AND FUSELAGE JACKS, THE MAIN GEAR WHEELS ARE CLEAR OF THE GROUND, AND THE HYDRAULIC POWER SYSTEM IS PRESSURIZED, THE AFT BOGIE AND WHEELS WILL SWING OUTBOARD VERY RAPIDLY IN THE DIRECTION OF NOSEWHEEL TURN IF THE NOSEWHEELS ARE TURNED MORE THAN 40 DEGREES. BOGIE AND MAIN GEAR AFT WHEELS WILL RETURN TO TRAIL POSITION JUST AS RAPIDLY WHEN THE NOSEWHEELS ARE RETURNED TO NEUTRAL POSITION. THIS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING NEAR THE WHEELS.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

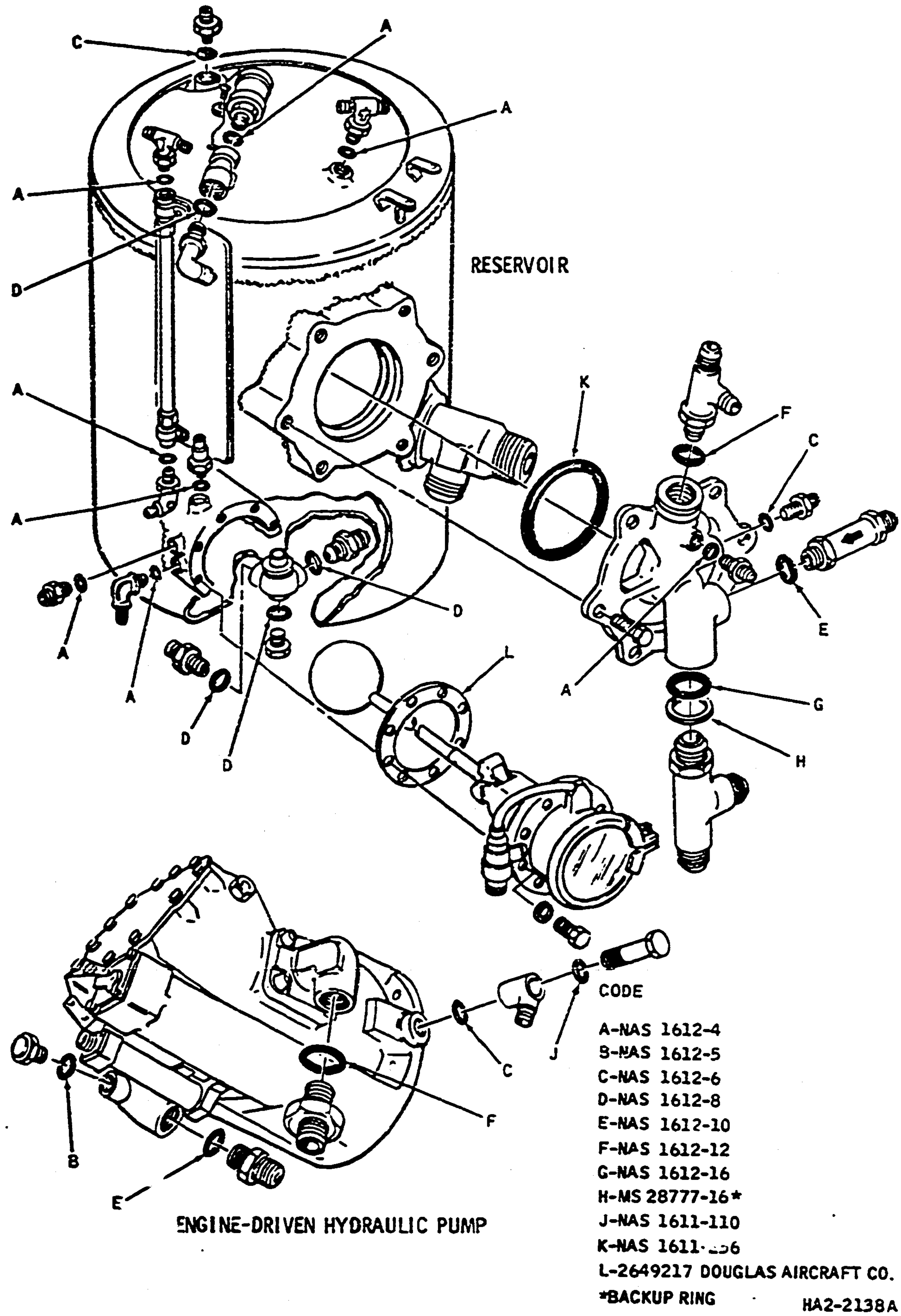
(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

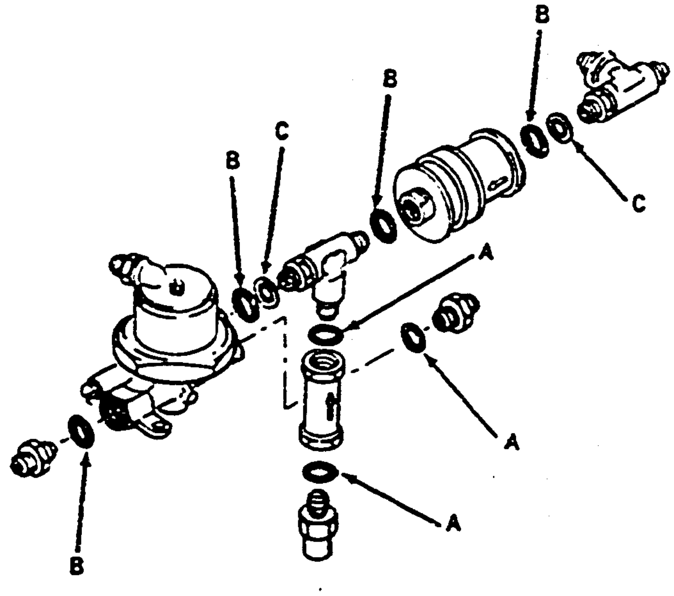
(5) Open four engine ejector and thrust brake indicator and ejector control circuit breakers located on fuel management and engine dc bus section of circuit breaker panel (airplanes 801-811).

WARNING: INADVERTENT OPERATION OF THE ENGINE EJECTORS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING IN THE ENGINE AREAS (AIRPLANES 801-811).

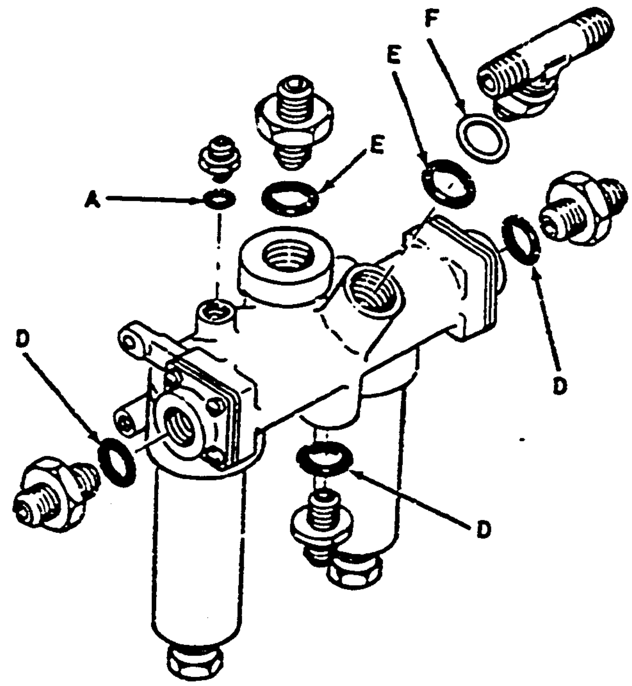
(6) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.



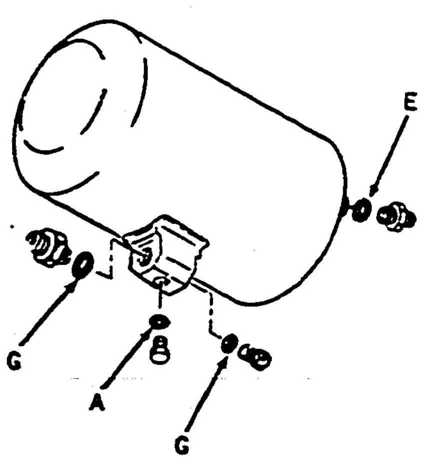
Hydraulic Power System Components -- O-Rings
(Airplanes 860-863)
Figure 201 (Sheet 1)



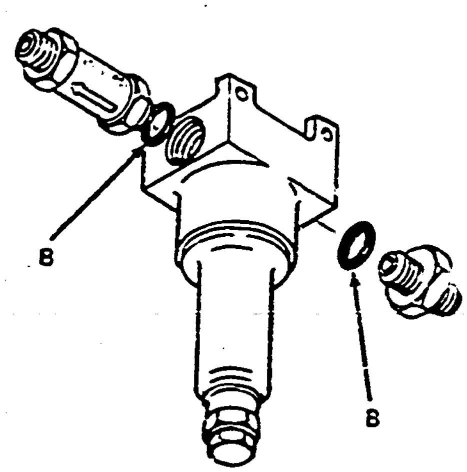
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



HYDRAULIC
PUMPCASE DRAIN
FILTER

CODE:
A - NAS1612-4
B - NAS1612-6
C - MS28777-6*
D - NAS1612-10
E - NAS1612-12
F - MS28777-12*
G - NAS1612-16
* - BACKUP RING

HA2-1101A

Hydraulic Power System Components -- O-Rings
(Airplanes 860-863)
Figure 201 (Sheet 2)

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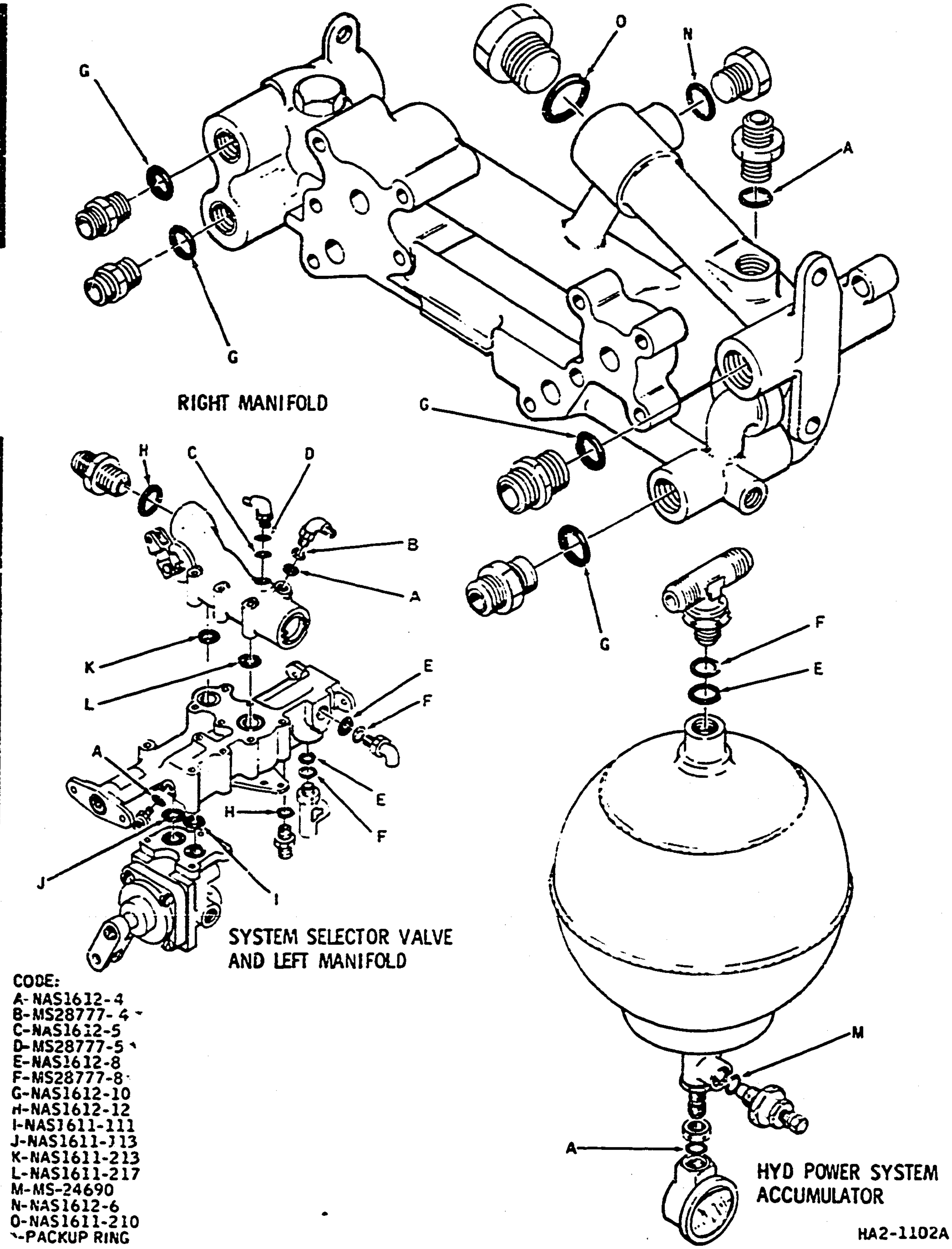
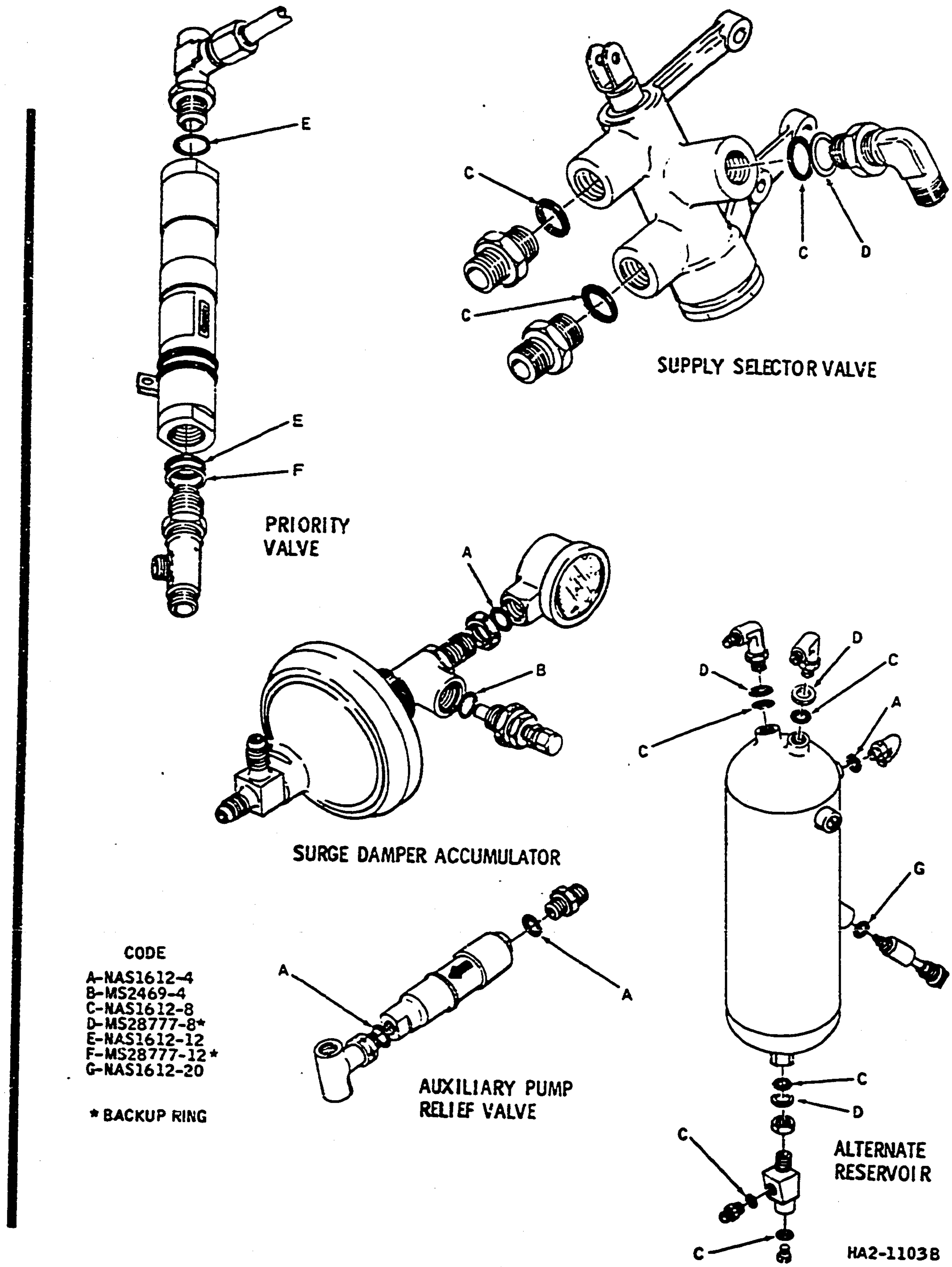


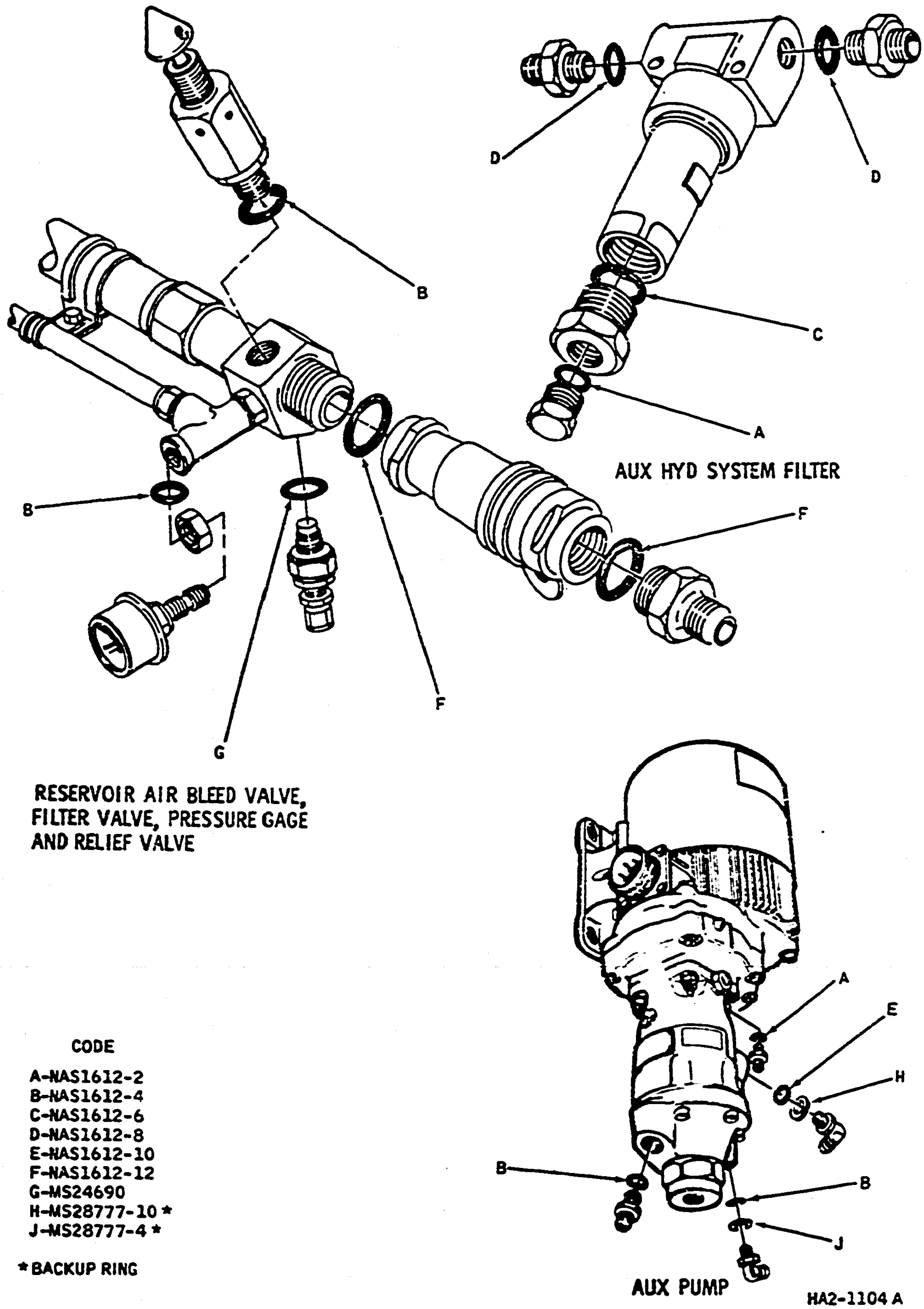
CODE:
A-NAS1612-4
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
I-NAS1611-111
J-NAS1611-113
K-NAS1611-213
L-NAS1611-217
M-MS-24690
N-NAS1612-6
O-NAS1611-210
*-PACKUP RING

HA2-1102A

Hydraulic Power System Components -- O-Rings
(Airplanes 860-863)
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-Rings
(Airplanes 860-863)
Figure 201 (Sheet 4)



CODE

A-NAS1612-2
B-NAS1612-4
C-NAS1612-6
D-NAS1612-8
E-NAS1612-10
F-NAS1612-12
G-MS24690
H-MS28777-10 *
J-MS28777-4 *

* BACKUP RING

Hydraulic Power System Components -- O-Rings
(Airplanes 860-863)
Figure 201 (Sheet 5)

(7) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System With Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Open four engine ejector and thrust brake indicator and ejector control circuit breakers located on fuel management and engine dc bus section of circuit breaker panel (airplanes 801-811).

WARNING: INADVERTENT OPERATION OF THE ENGINE EJECTORS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING IN THE ENGINE AREAS (AIRPLANES 801-811).

(5) Check that airplane electrical buses are energized (see Chapter 24).

(6) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System With Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Open four engine ejector and thrust brake indicator and ejector control circuit breakers located on fuel management and engine dc bus section of circuit breaker panel (airplanes 801-811).

WARNING: INADVERTENT OPERATION OF THE ENGINE EJECTORS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING IN THE ENGINE AREAS (AIRPLANES 801-811).

(6) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(7) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 35 and 40 psi on airplanes 801-815 and 30 and 35 psi on airplanes 816-822, 860-863.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 35 to 40 psi reading on air pressure gage on airplanes 801-815 or 30 to 35 psi reading on air pressure gage on airplanes 816-822 and 860-863.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) On airplanes 801-811, disconnect alternate reservoir outlet line at auxiliary hydraulic pump selector valve and drain alternate reservoir fluid into suitable container.

(2) On airplanes 812-822, 860-863, remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(3) Pressurized main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on a airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be

more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Company, or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be checked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

(4) The main gear bogie beams should be locked in the trail position at all times, except as noted in maintenance procedural steps.

WARNING: WHEN THE AIRPLANE IS ON WING AND FUSELAGE JACKS, THE MAIN GEAR WHEELS ARE CLEAR OF THE GROUND, AND THE HYDRAULIC POWER SYSTEM IS PRESSURIZED, THE AFT BOGIE AND WHEELS WILL SWING OUTBOARD VERY RAPIDLY IN THE DIRECTION OF NOSEWHEEL TURN IF THE NOSEWHEELS ARE TURNED MORE THAN 40 DEGREES. BOGIE AND MAIN GEAR AFT WHEELS WILL RETURN TO TRAIL POSITION JUST AS RAPIDLY WHEN THE NOSEWHEELS ARE RETURNED TO NEUTRAL POSITION. THIS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING NEAR THE WHEELS.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

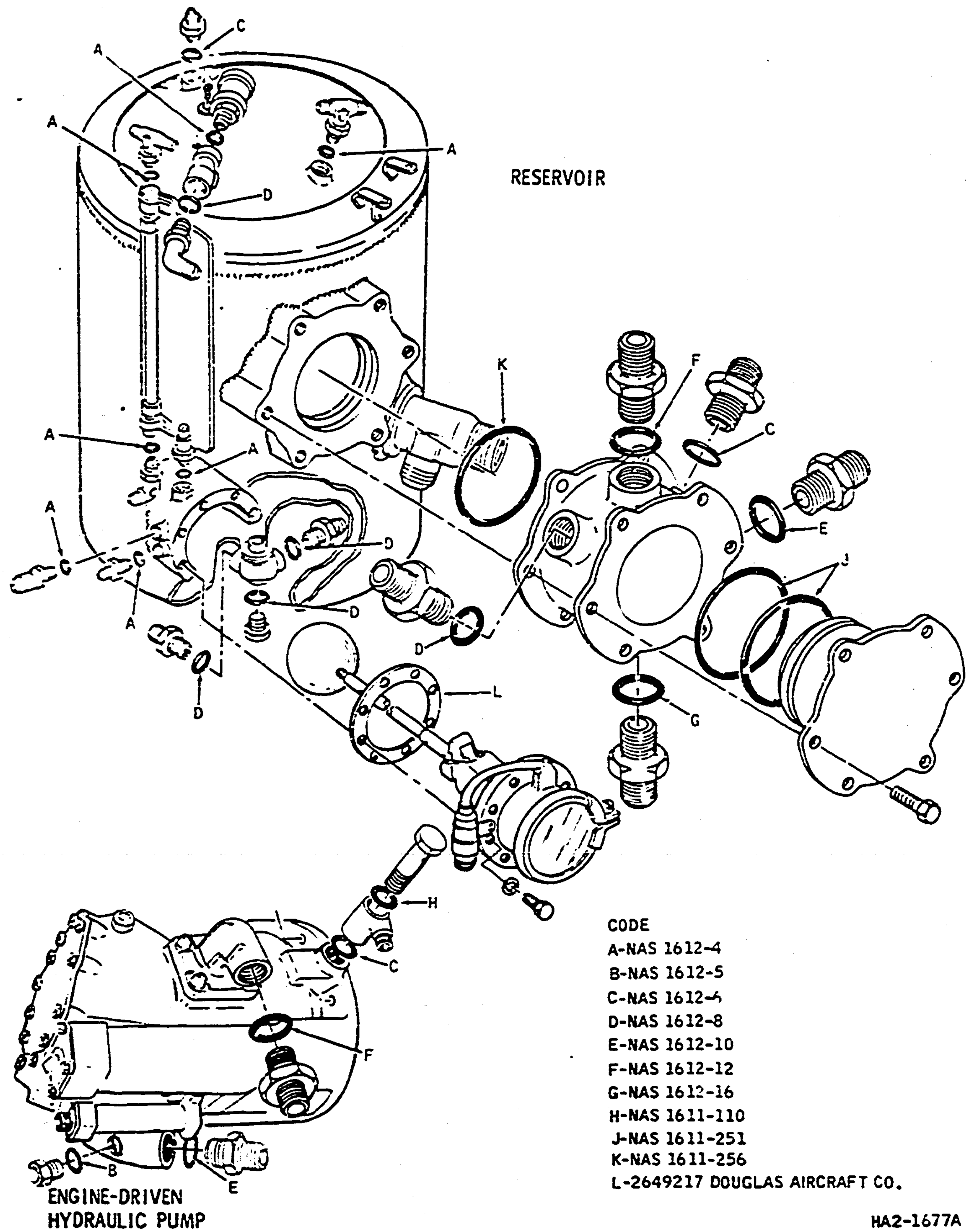
(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

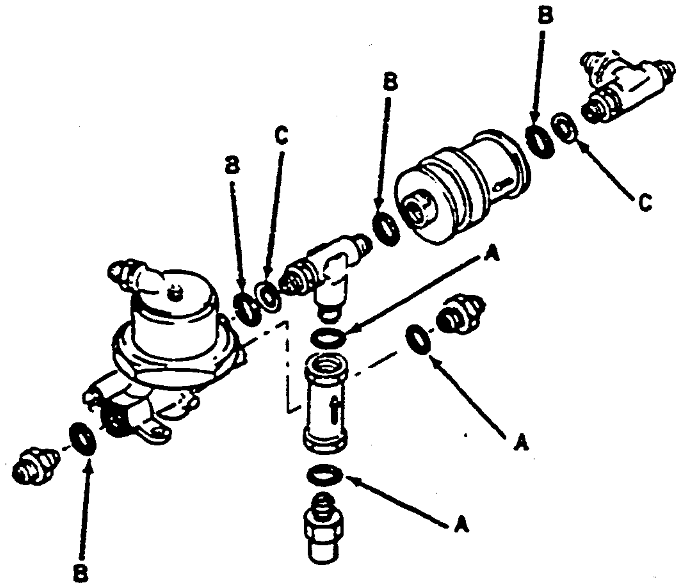
(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

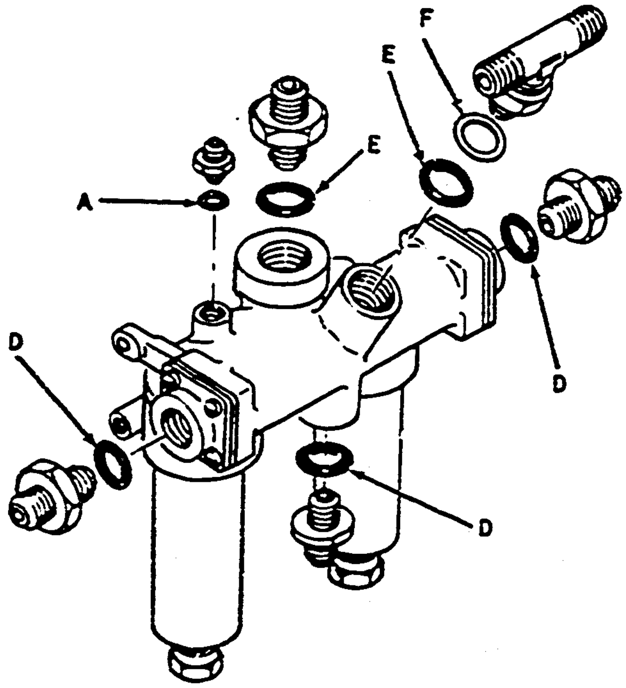


CODE
A-NAS 1612-4
B-NAS 1612-5
C-NAS 1612-6
D-NAS 1612-8
E-NAS 1612-10
F-NAS 1612-12
G-NAS 1612-16
H-NAS 1611-110
J-NAS 1611-251
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

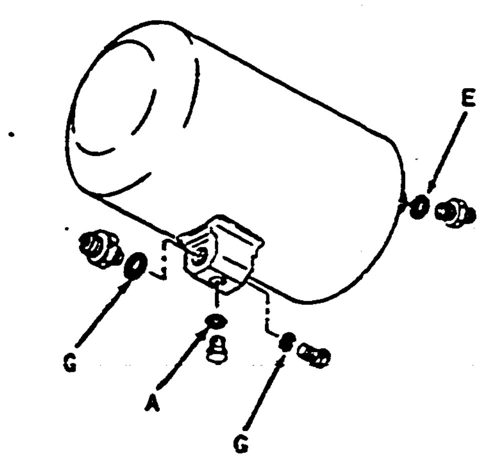
Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



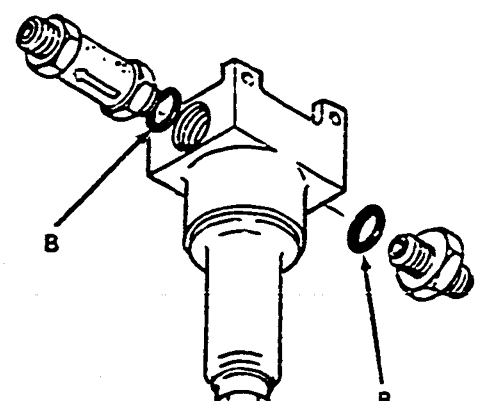
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



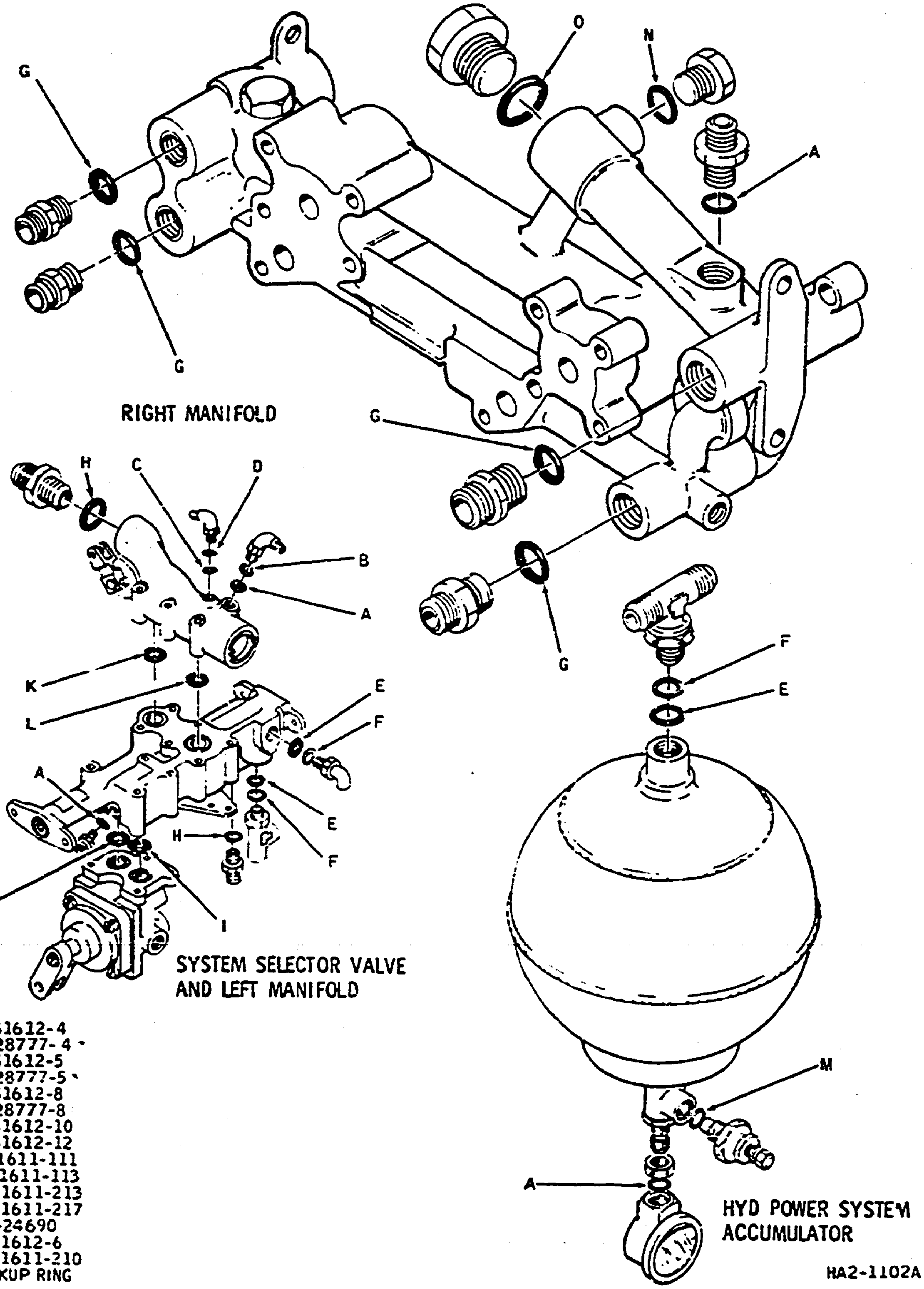
HYDRAULIC
PUMPCASE DRAIN
FILTER

CODE:

A - NAS1612-4
B - NAS1612-6
C - MS28777-6*
D - NAS1612-10
E - NAS1612-12
F - MS28777-12*
G - NAS1612-16
* - BACKUP RING

HA2-1101A

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 2)



CODE:
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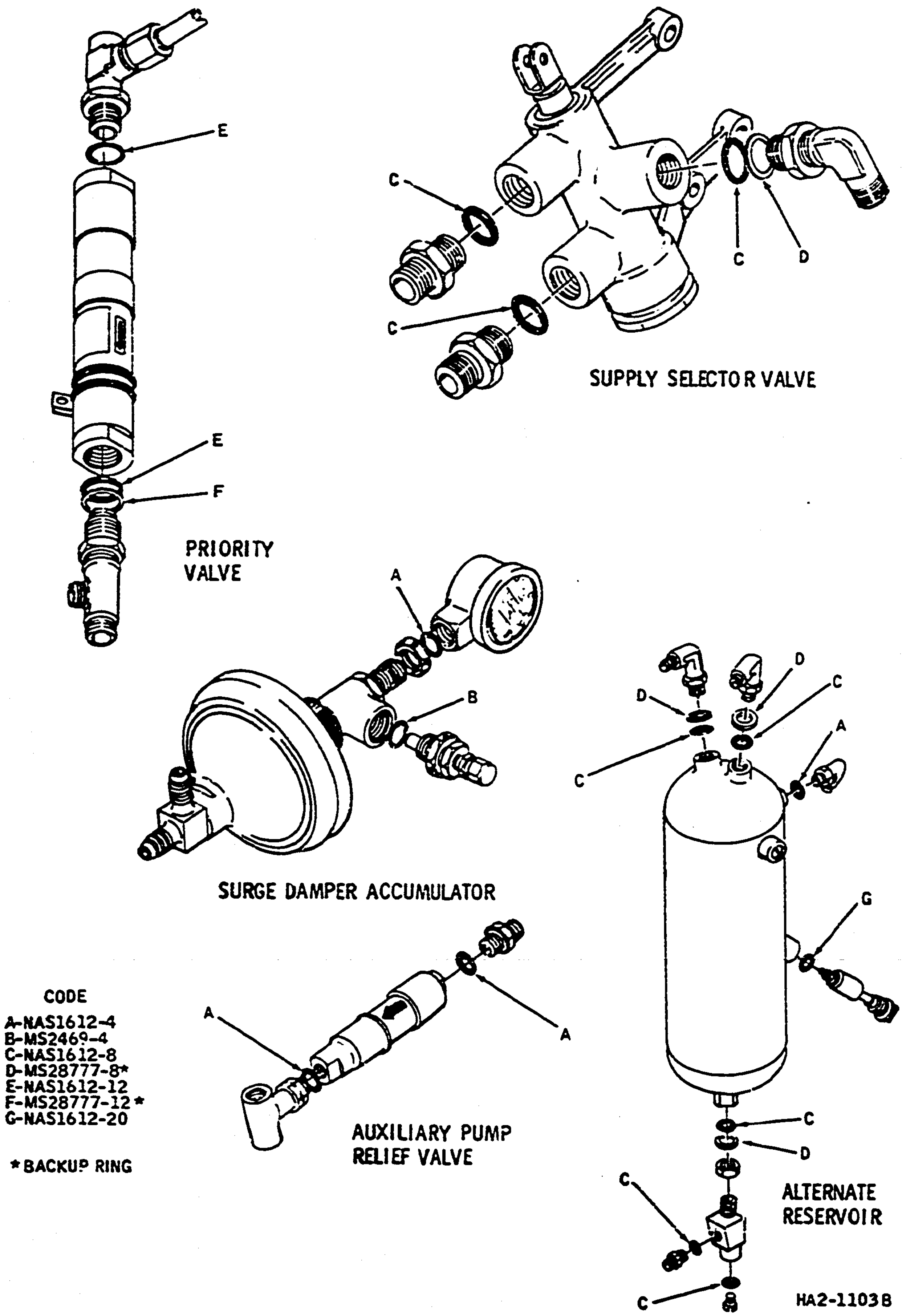
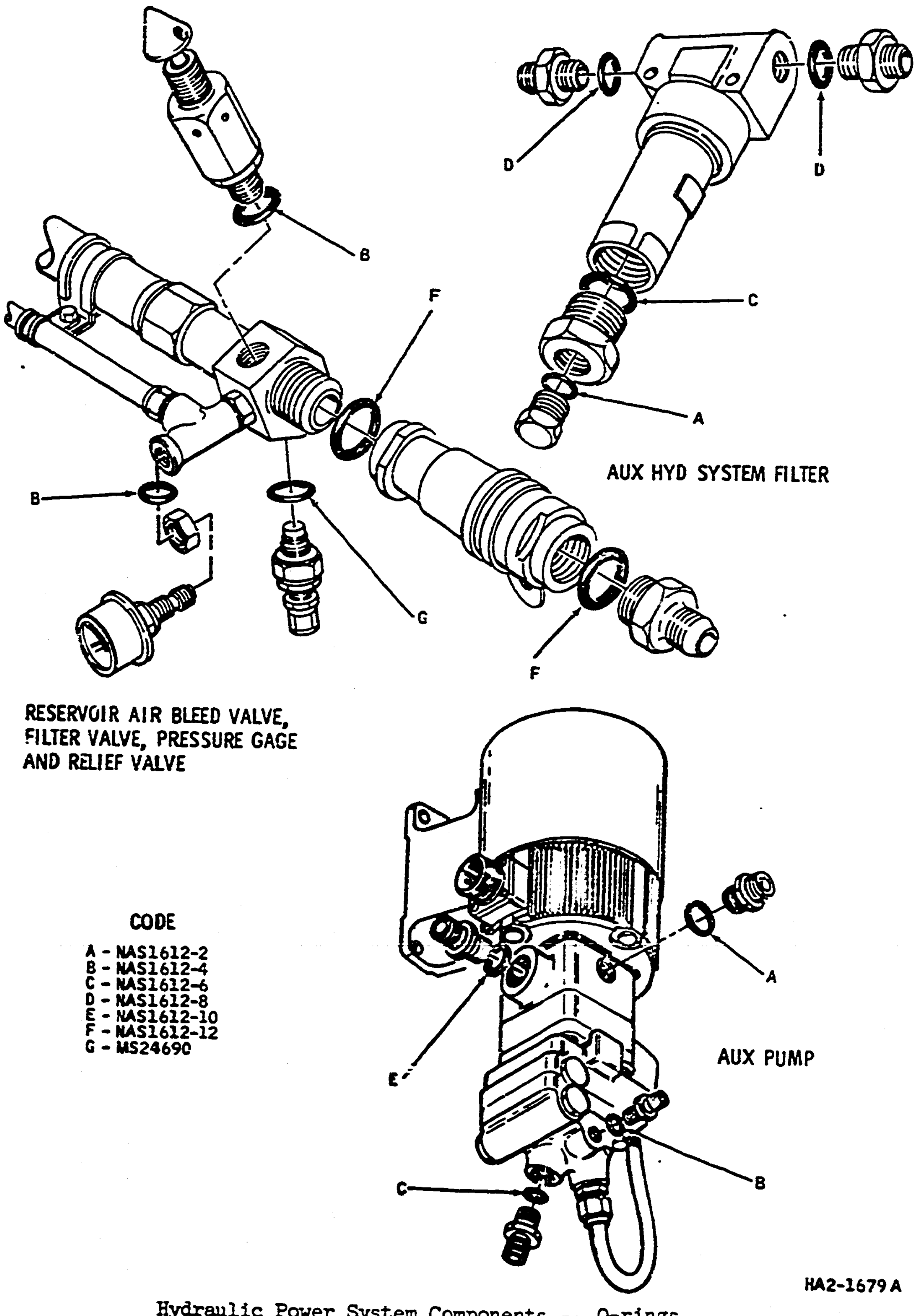
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8
G-NAS1612-10
H-NAS1612-12
I-NAS1611-111
J-NAS1611-113
K-NAS1611-213
L-NAS1611-217
M-MS-24690
N-NAS1612-6
O-NAS1611-210
*-BACKUP RING

Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- O-rings
Figure 201 (Sheet 5)

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System with Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical busses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System with Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

<u>WARNING:</u> BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. <u>Pressuriz./Depressurize Hydraulic Reservoir</u>

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The

hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal)

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position

(c) Manual main gear door valve open

(d) Landing gear down and locked

(e) Wing flaps up

(f) Accumulators properly charged

(g) Aileron shutoff valve off

(h) Rudder shutoff valve off

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components on systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foriegn objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Company, or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be checked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

(4) The main gear bogie beams should be locked in the trail position at all times, except as noted in maintenance procedural steps.

WARNING: WHEN THE AIRPLANE IS ON WING AND FUSELAGE JACKS, THE MAIN GEAR WHEELS ARE CLEAR OF THE GROUND, AND THE HYDRAULIC POWER SYSTEM IS PRESSURIZED, THE AFT BOGIE AND WHEELS WILL SWING OUTBOARD VERY RAPIDLY IN THE DIRECTION OF NOSEWHEEL TURN IF THE NOSEWHEELS ARE TURNED MORE THAN 40 DEGREES. BOGIE AND MAIN GEAR AFT WHEELS WILL RETURN TO TRAIL POSITION JUST AS RAPIDLY WHEN THE NOSEWHEELS ARE RETURNED TO NEUTRAL POSITION. THIS COULD CAUSE SERIOUS INJURY TO PERSONNEL WORKING NEAR THE WHEELS.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

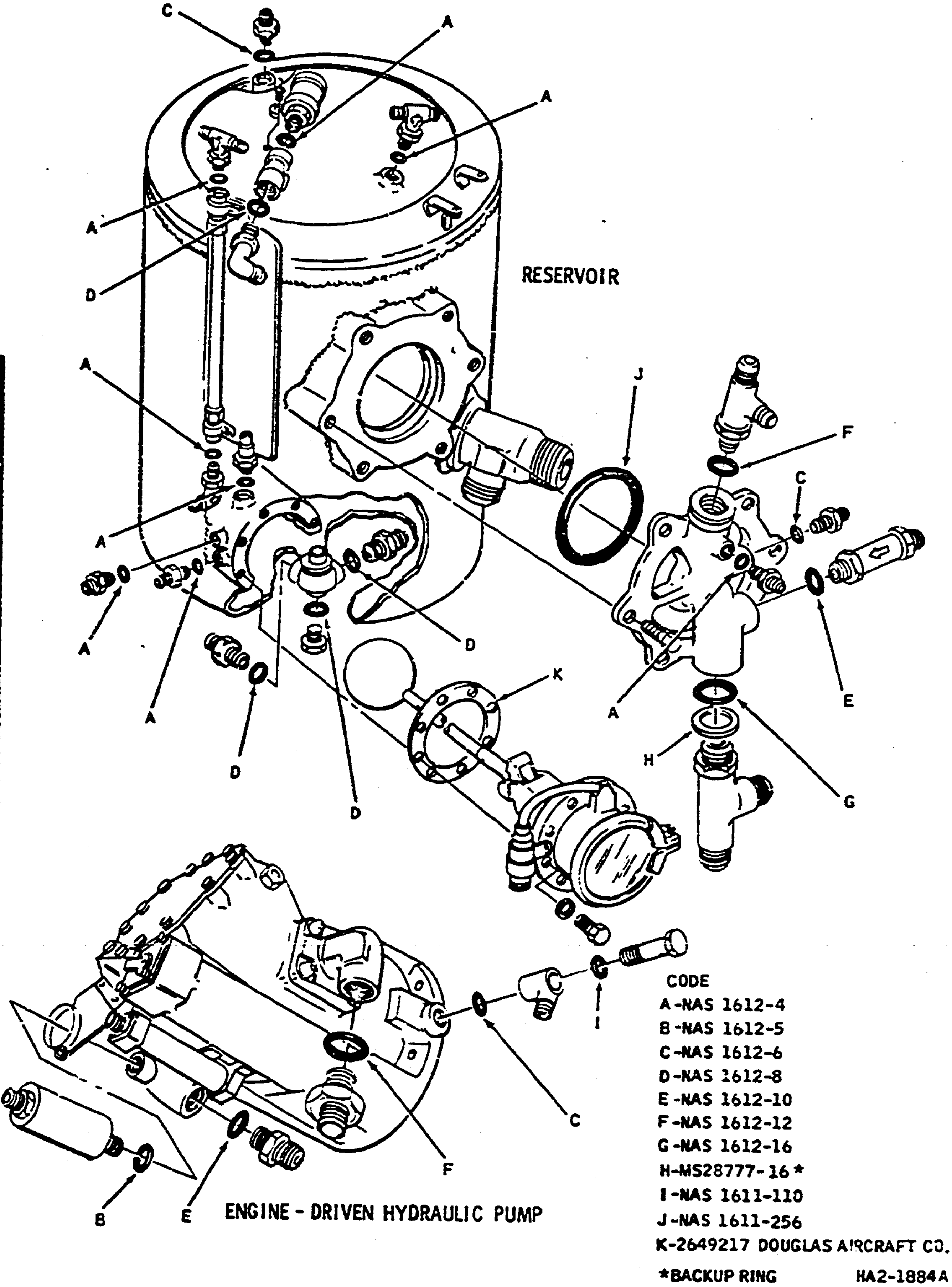
(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

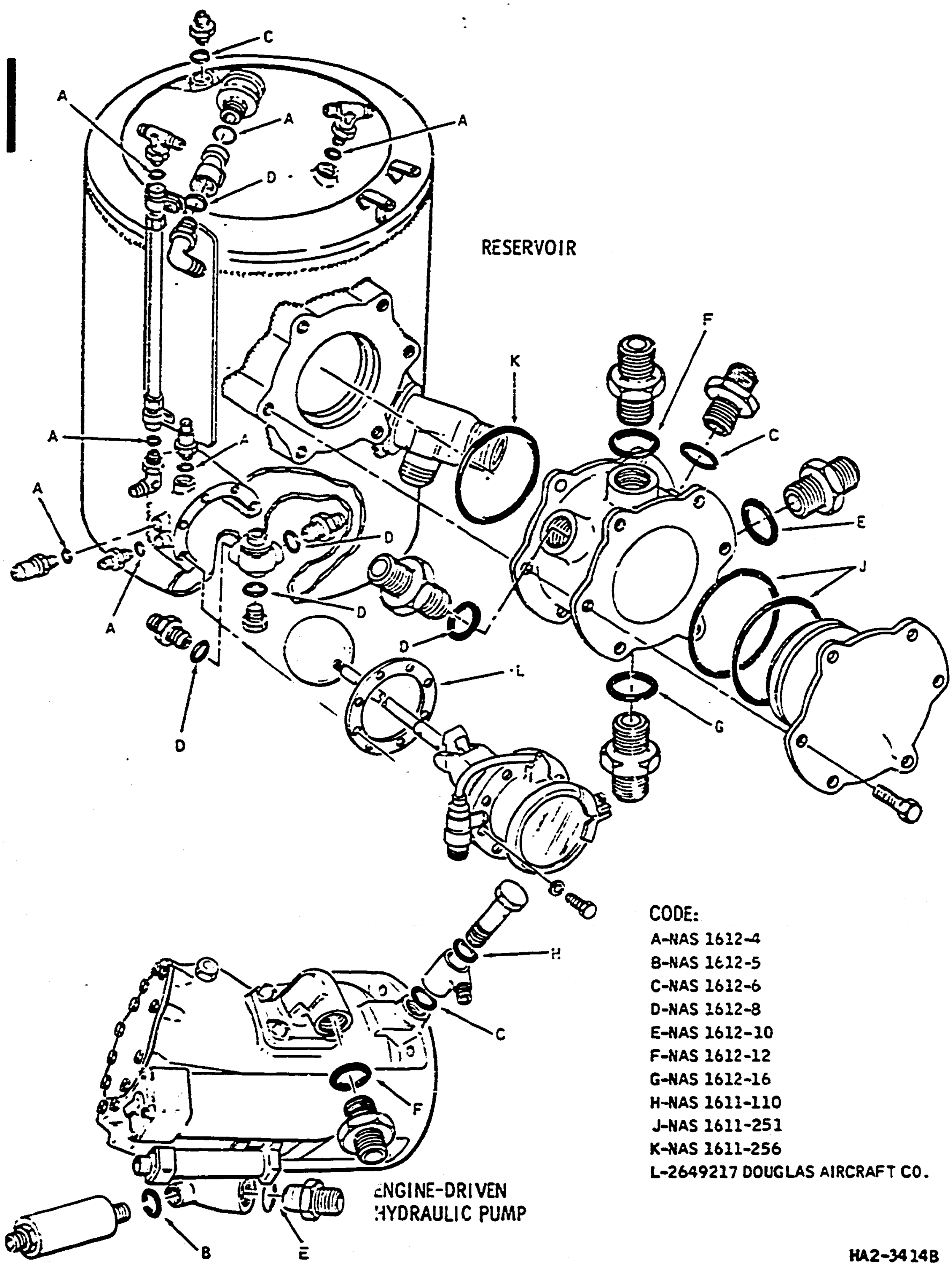
(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

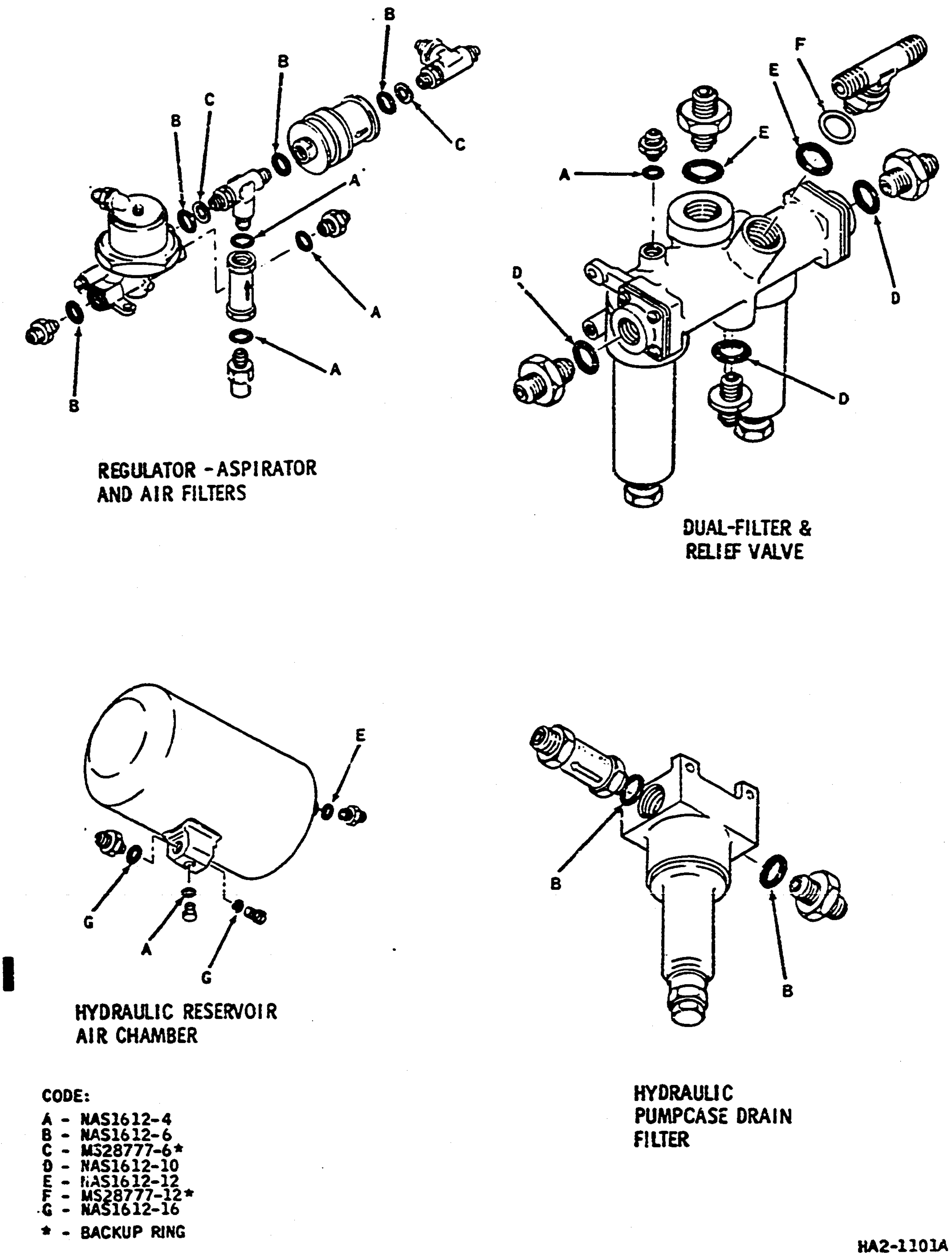
(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.



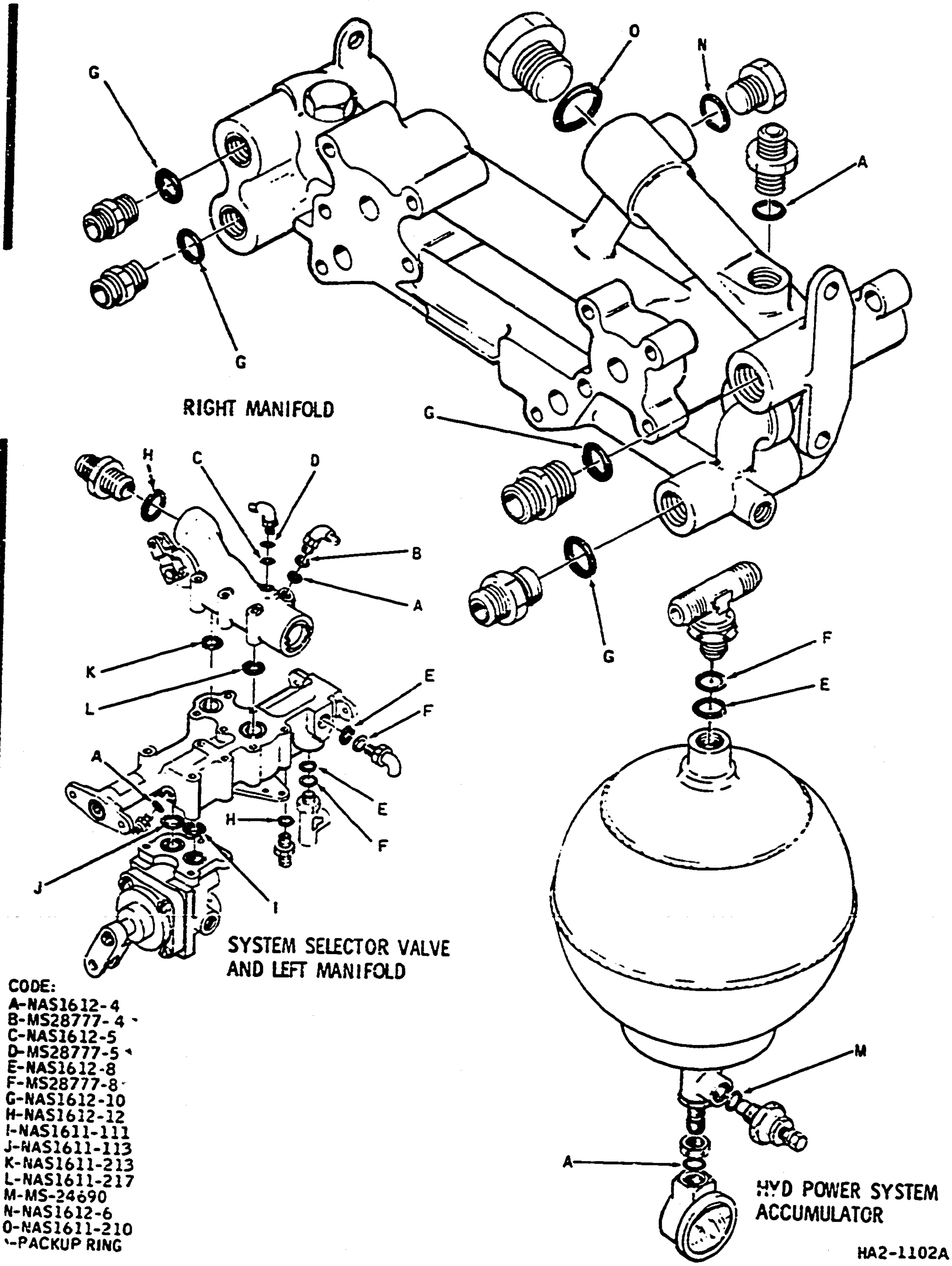
Hydraulic Power System Components -- O-Rings
(Airplane N8786R)
Figure 201 (Sheet 1)



Hydraulic Power System Components — O-Rings
(Airplane N8787R and Subsequent)
Figure 201 (Sheet 2)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 3)



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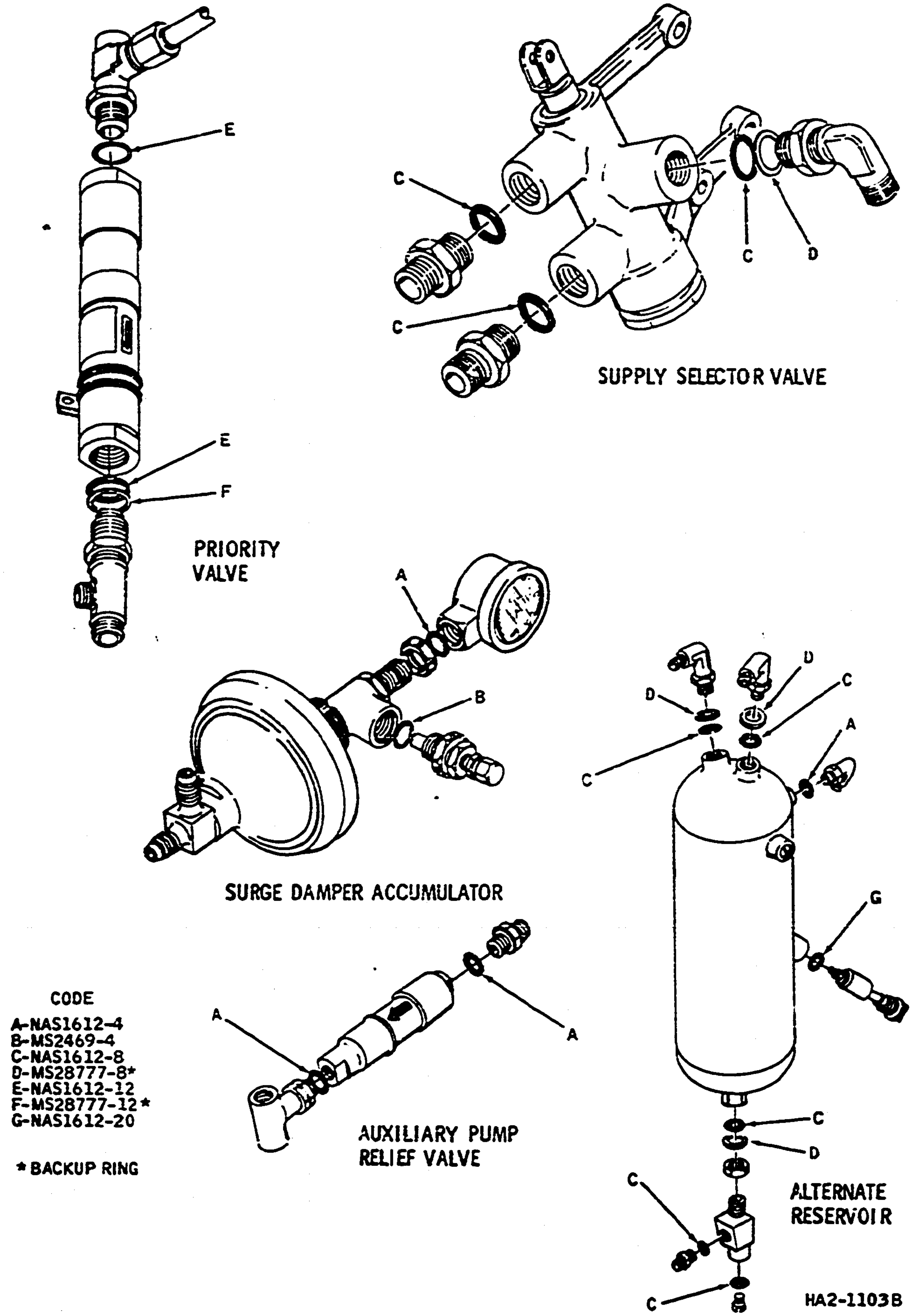
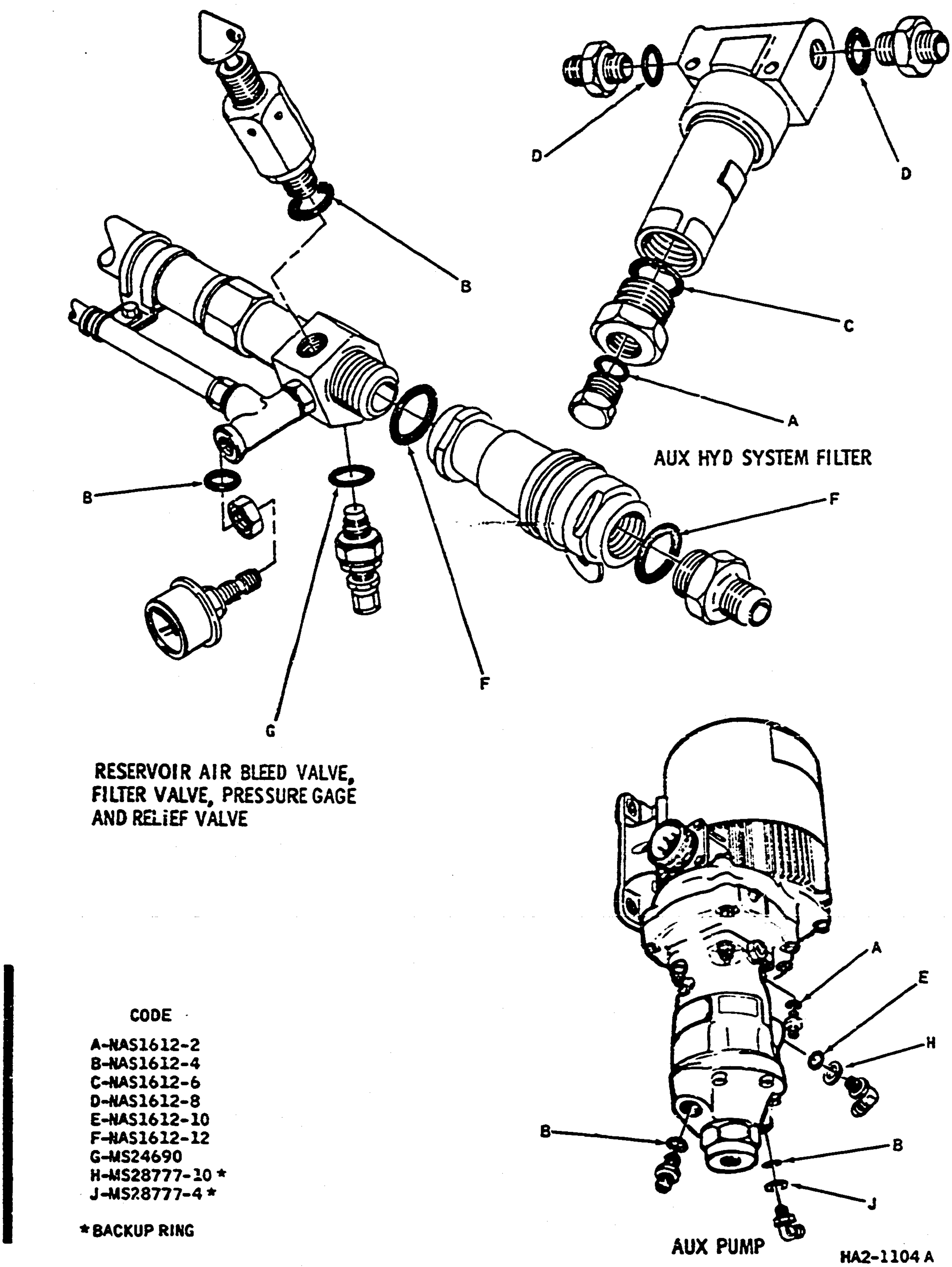
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
I-NAS1611-111
J-NAS1611-113
K-NAS1611-213
L-NAS1611-217
M-MS-24690
N-NAS1612-6
O-NAS1611-210
*-PACKUP RING

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 5)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 6)

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System with Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System with Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic Systems Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determine the minimum time permissible for pressure decay. The

hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the hose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

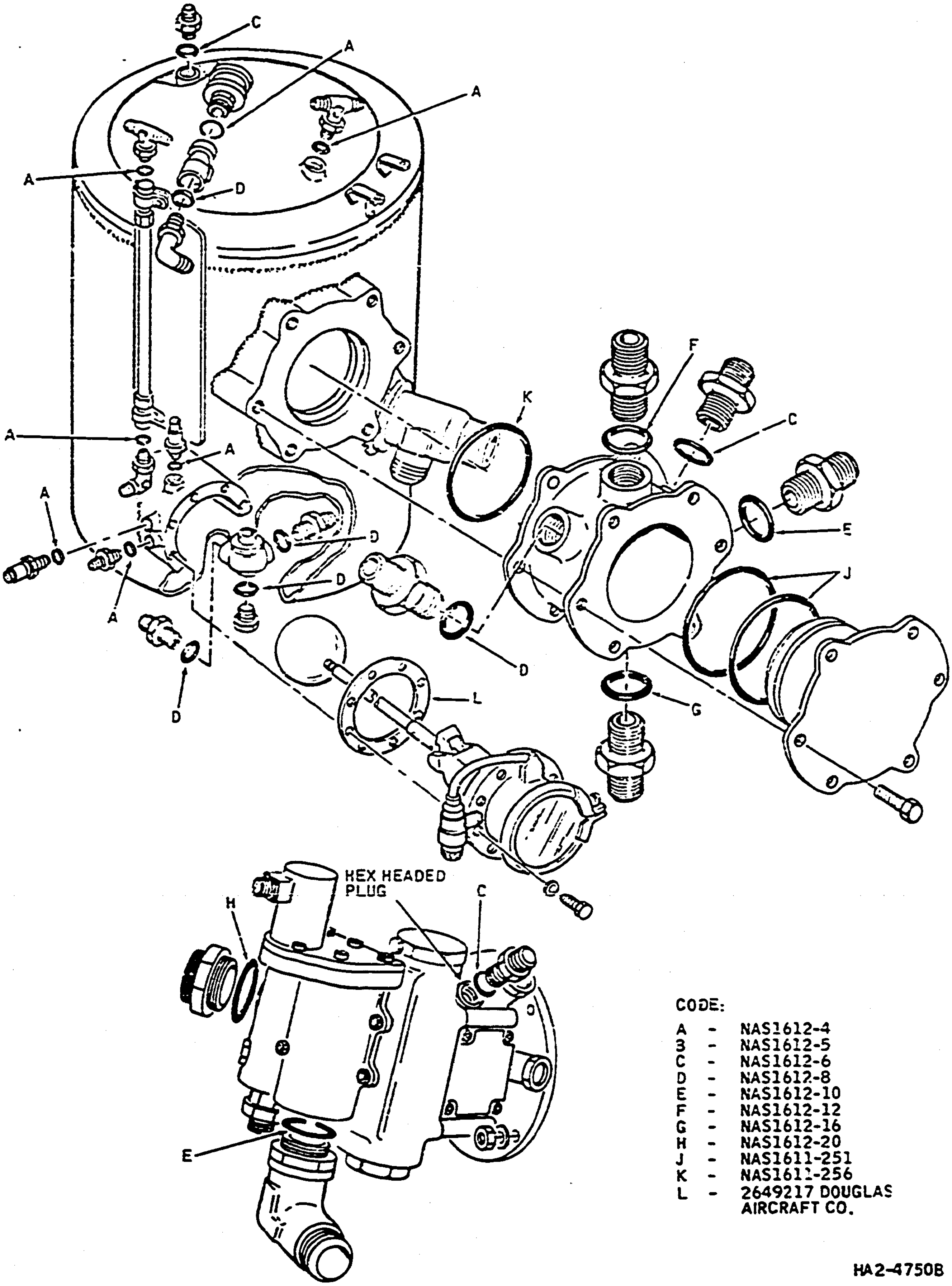
(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control system, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.



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D - NAS1612-8
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F - NAS1612-12
G - NAS1612-16
H - NAS1612-20
J - NAS1611-251
K - NAS1611-256
L - 2649217 DOUGLAS AIRCRAFT CO.

HA2-4750B

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)

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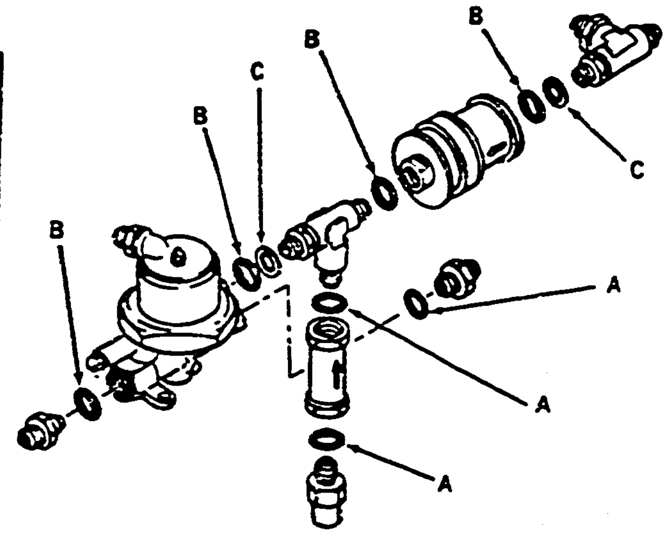
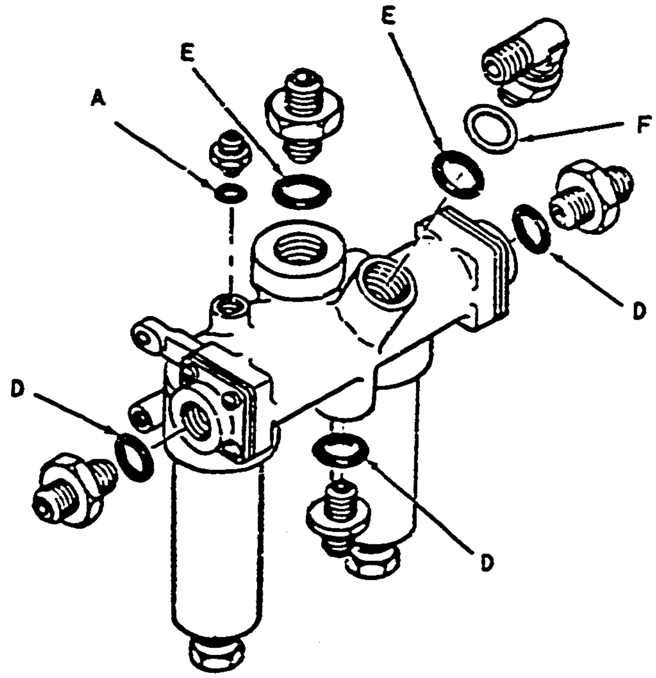
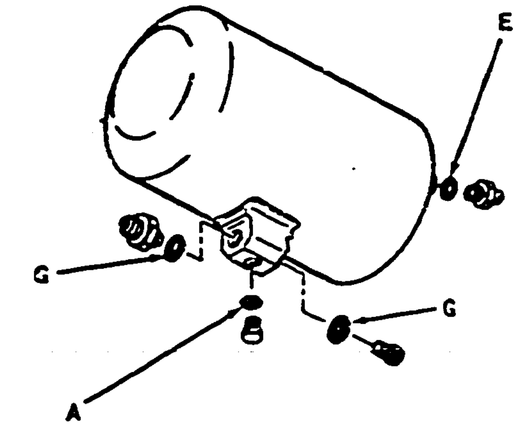


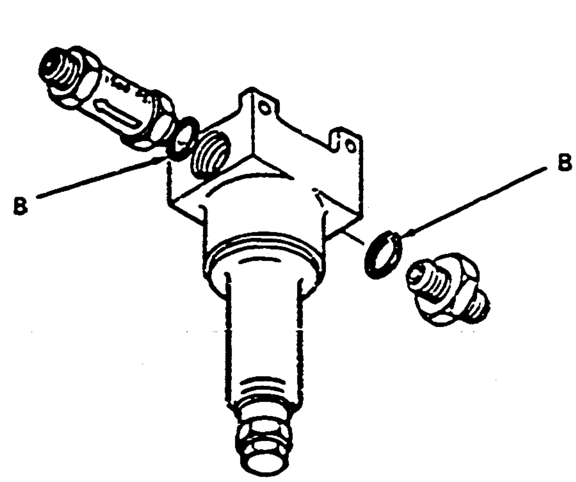
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



HYDRAULIC
PUMPCASE DRAIN
FILTER

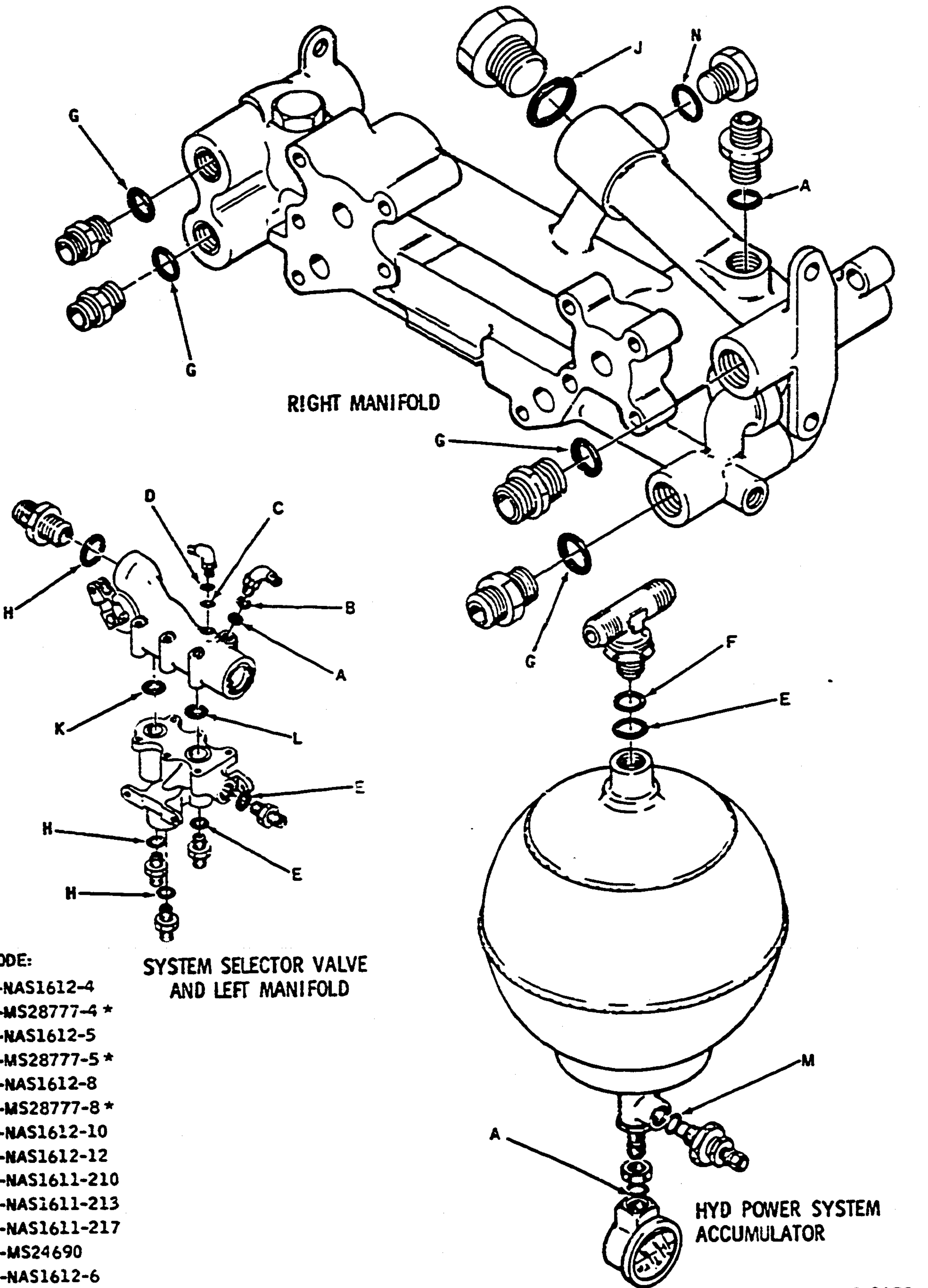
CODE

A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16

* - BACKUP RING

HA2-3415B

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 2)



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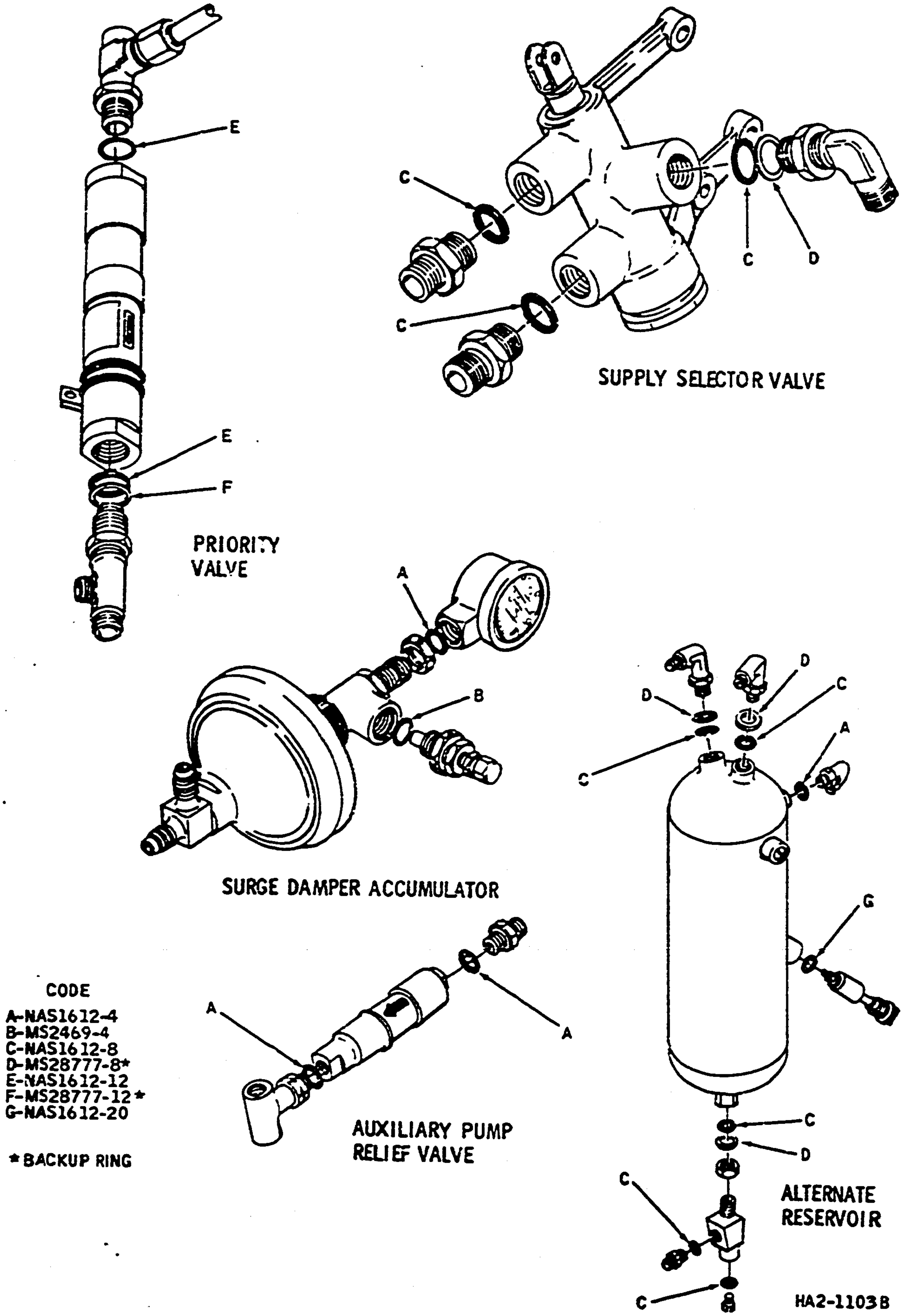
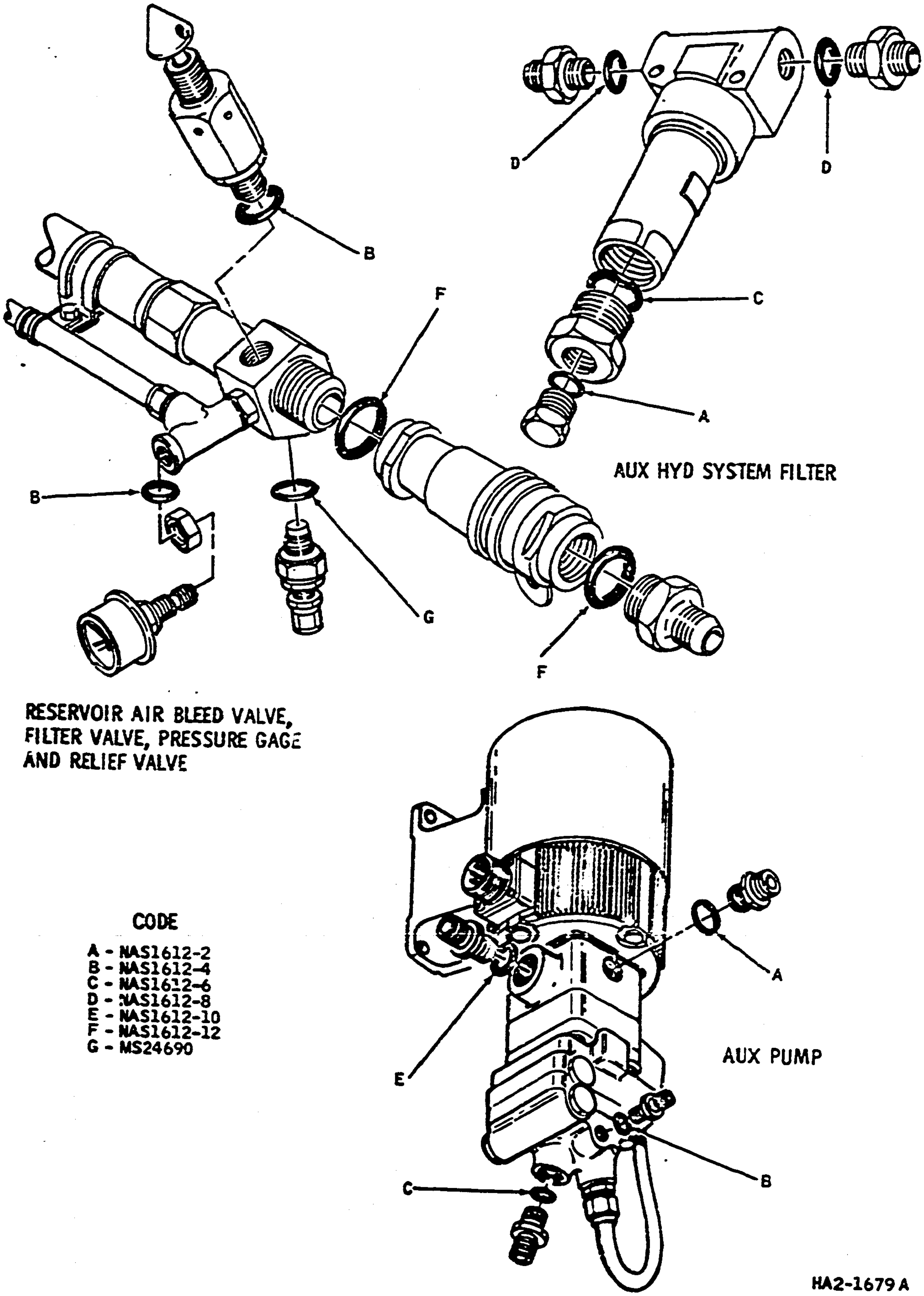
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 3)

Printed in U.S.A.



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 4)



CODE

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C - NAS1612-6
D - NAS1612-8
E - NAS1612-10
F - NAS1612-12
G - MS24690

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 5)

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System with Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System with Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

<u>WARNING</u>: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. <u>Pressurize/Depressurize Hydraulic Reservoir</u>

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air hamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

<u>NOTE</u>: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

<u>NOTE</u>: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

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(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. <u>Hydraulic System Pressure Decay Rates</u>

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed.

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This

should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seocnds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off, and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) The thrust reverser system is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and throughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands throughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating throughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

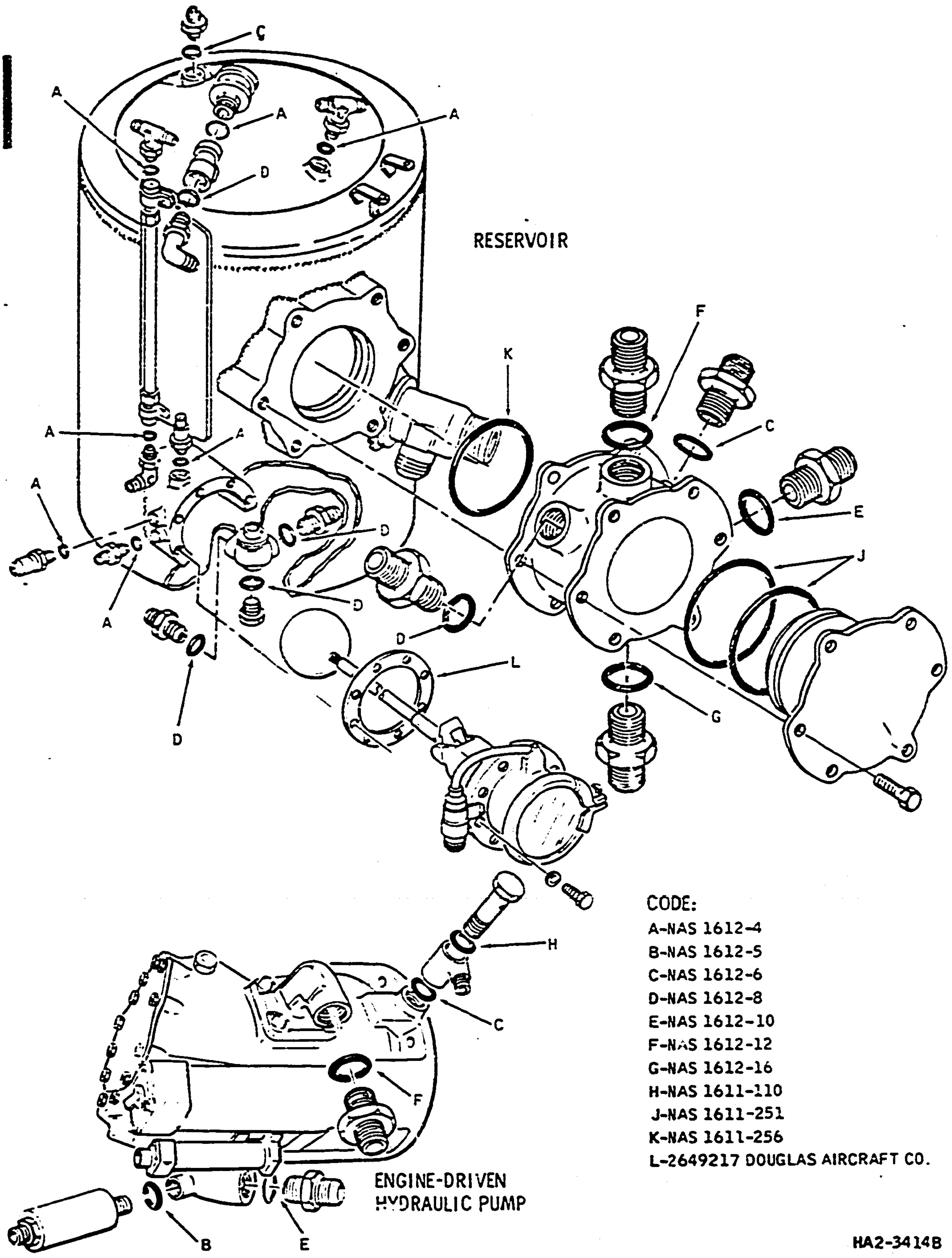
(6) Energize test stand hydraulic pump pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

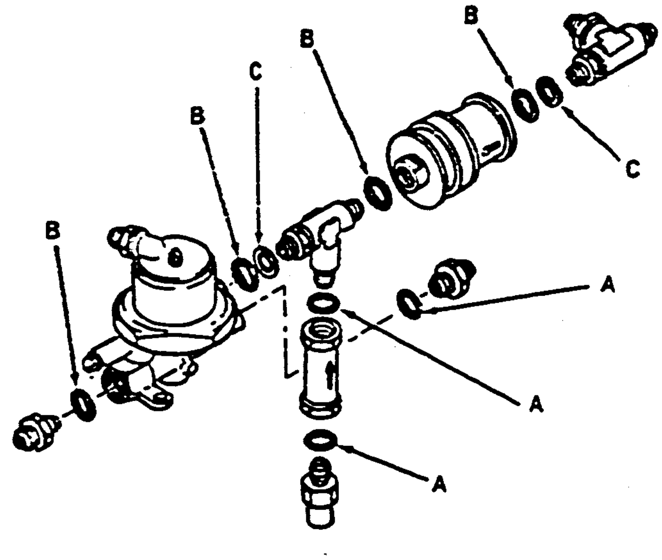
(2) Deenergize test stand hydraulic pump.



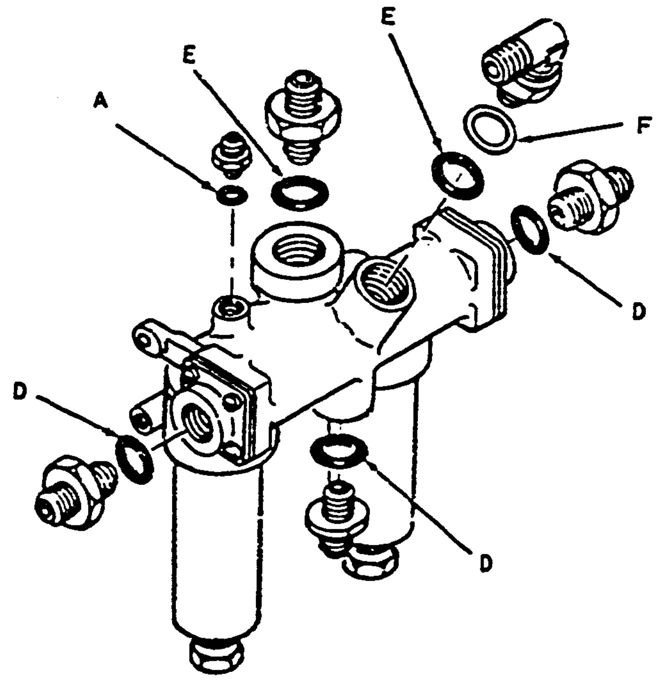
CODE:
A-NAS 1612-4
B-NAS 1612-5
C-NAS 1612-6
D-NAS 1612-8
E-NAS 1612-10
F-NAS 1612-12
G-NAS 1612-16
H-NAS 1611-110
J-NAS 1611-251
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

HA2-3414B

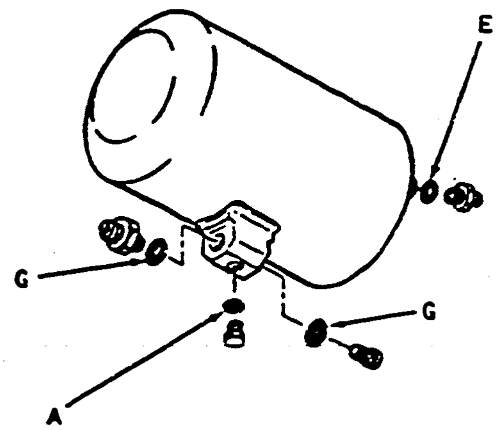
Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



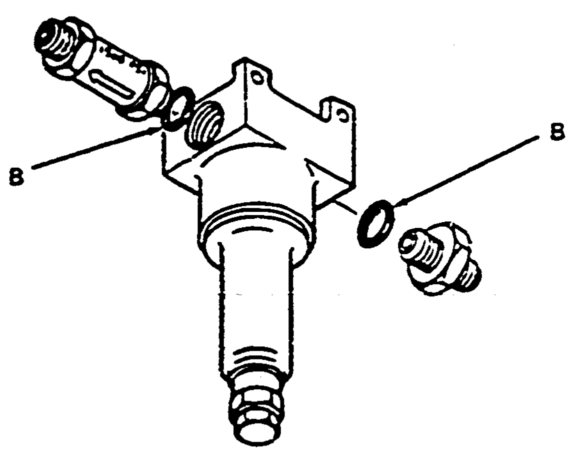
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



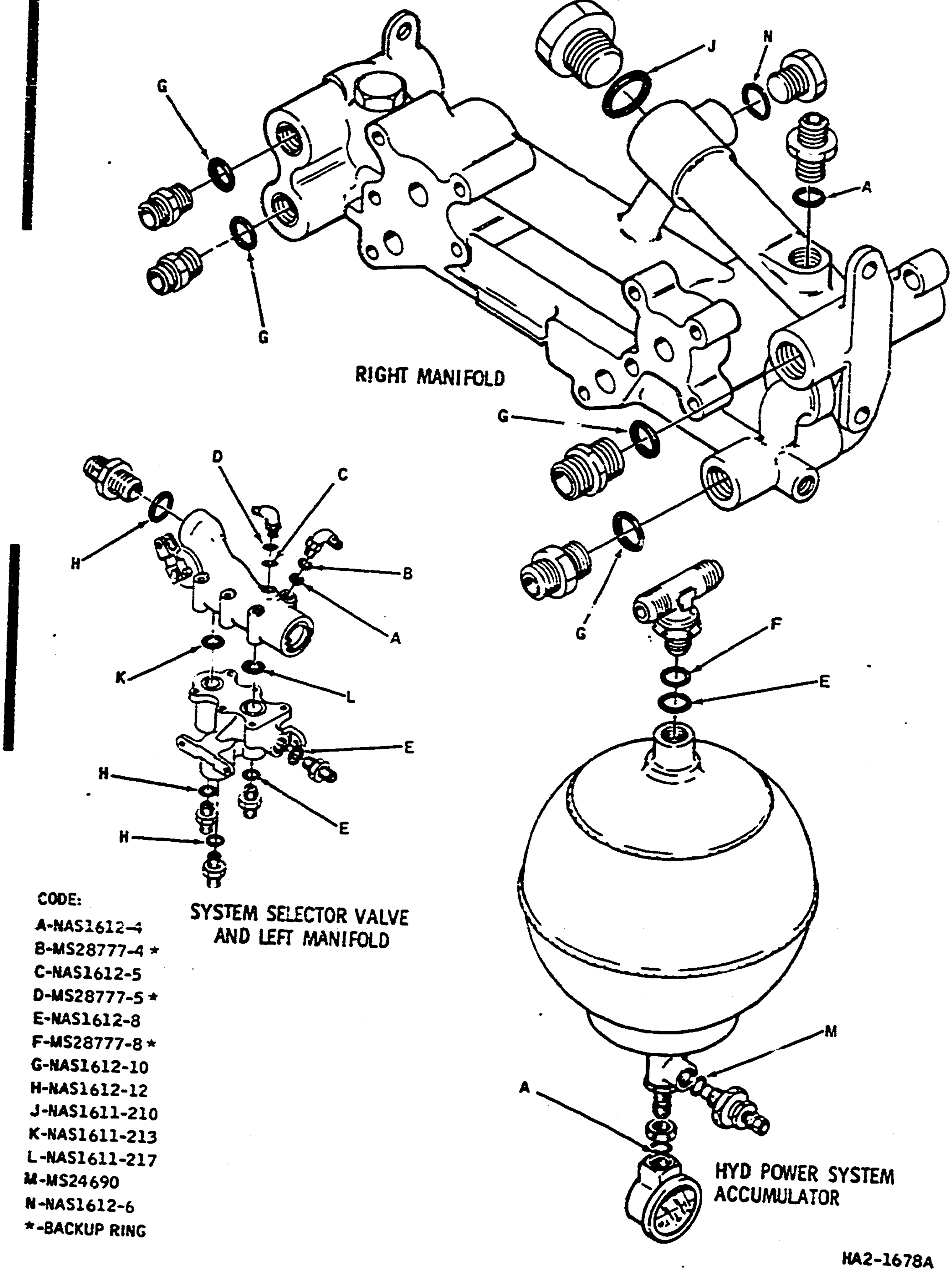
HYDRAULIC
PUMPCASE DRAIN
FILTER

CODE

A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16
* - BACKUP RING

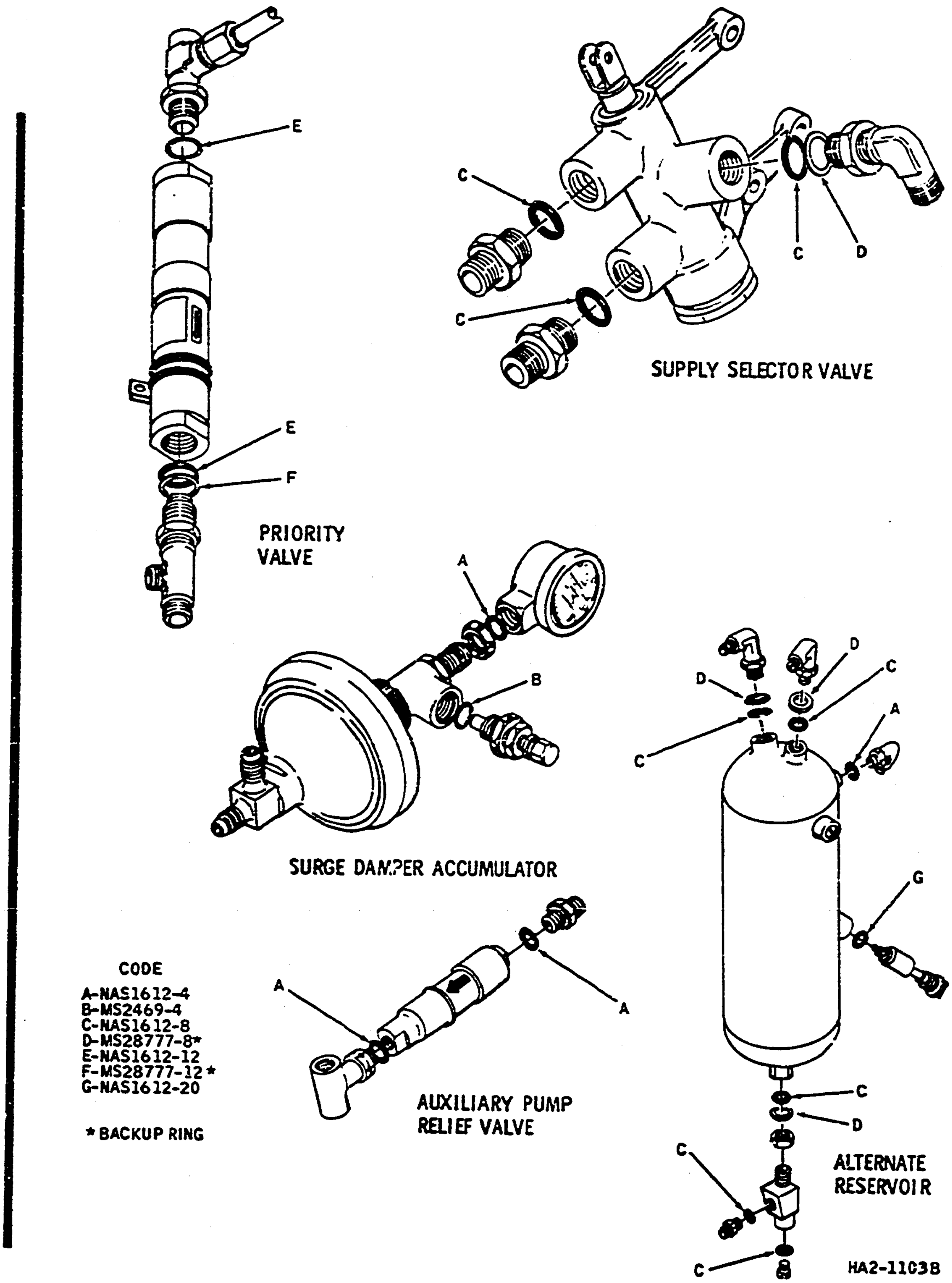
HA2-34158

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 2)

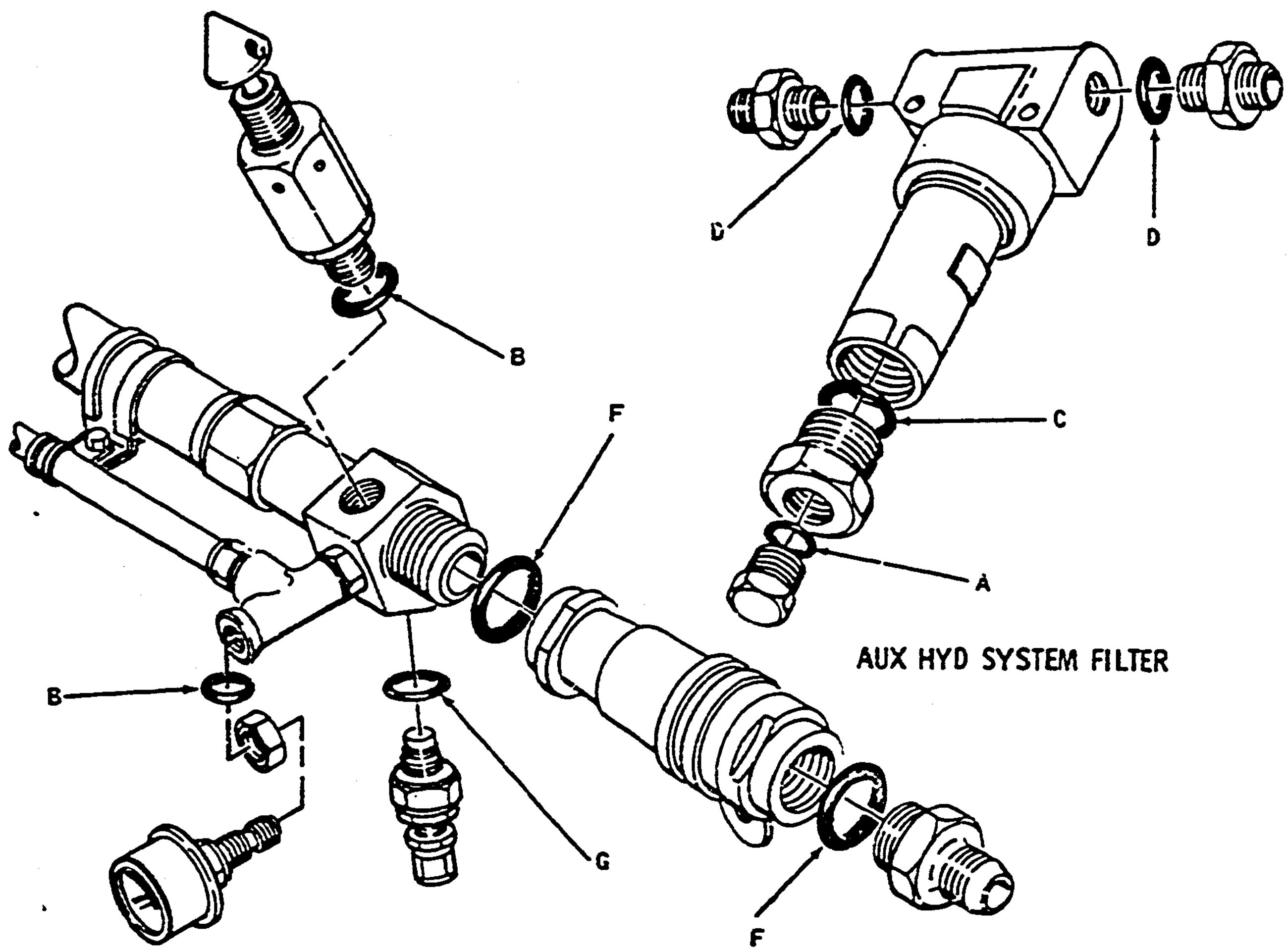


CODE:
A-NAS1612-4
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 4)

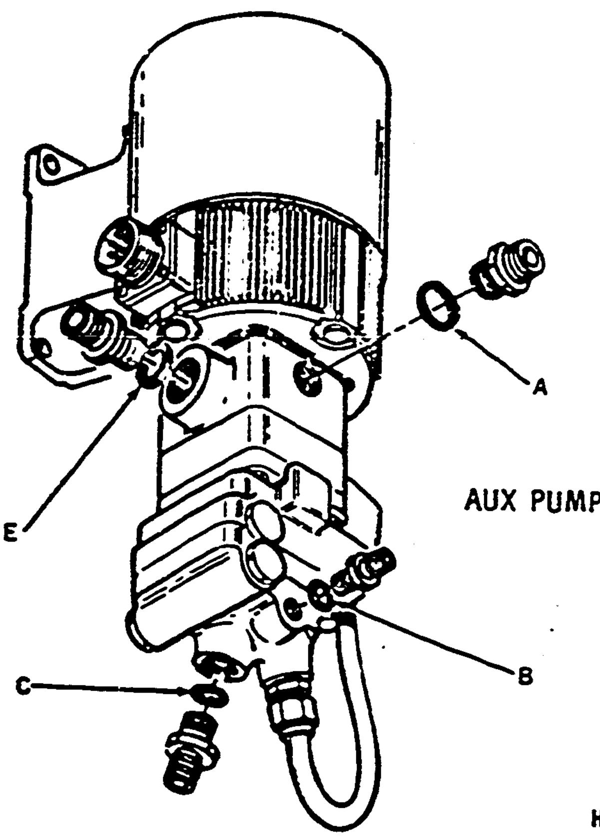


AUX HYD SYSTEM FILTER

RESERVOIR AIR BLEED VALVE,
FILTER VALVE, PRESSURE GAGE
AND RELIEF VALVE

CODE

A - NAS1612-2
B - NAS1612-4
C - NAS1612-6
D - NAS1612-8
E - NAS1612-10
F - NAS1612-12
G - MS24690



AUX PUMP

HA2-1679 A

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 5)

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(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System with Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

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E. Pressurize Hydraulic System with Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

<u>WARNING</u>: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. <u>Pressurize/Depressurize Hydraulic Reservoir</u>

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear door valve open.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed.

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, or the selector valve. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time

should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking breke on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

<u>CAUTION</u>: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) The thrust reverser system is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating throughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, throughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System With External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.

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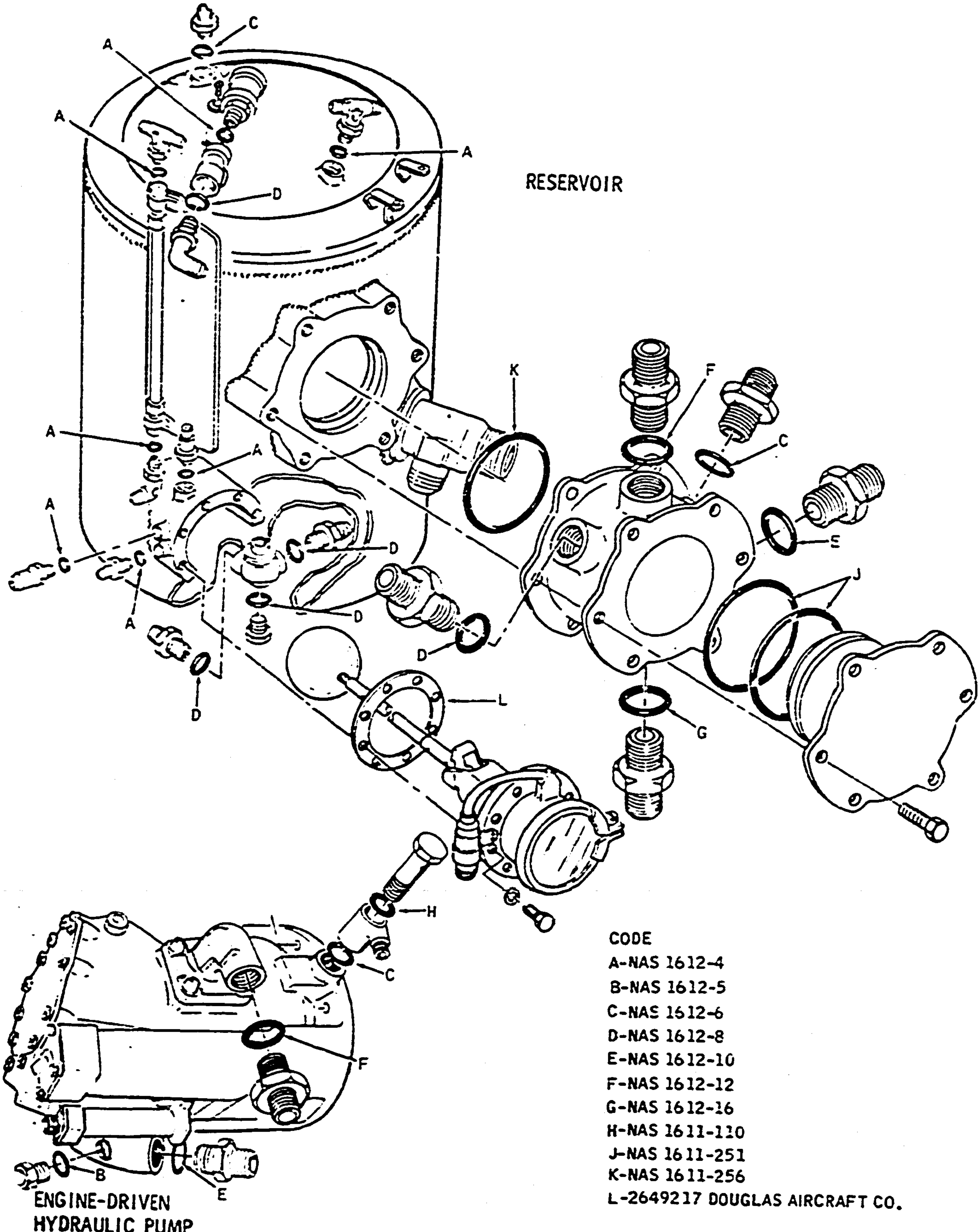

CODE
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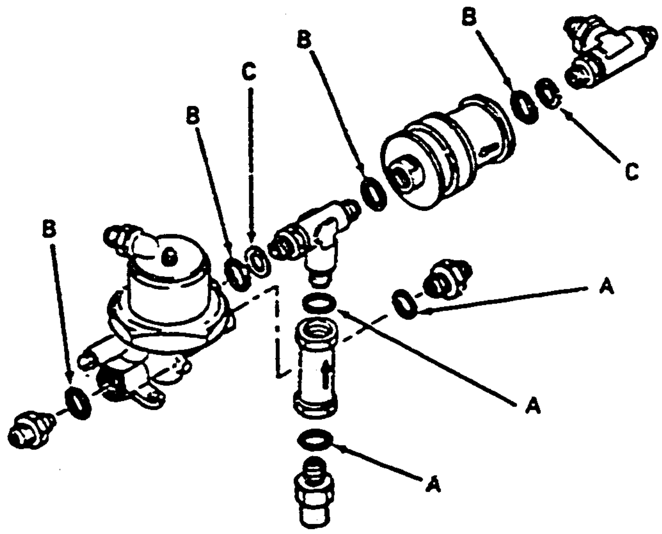
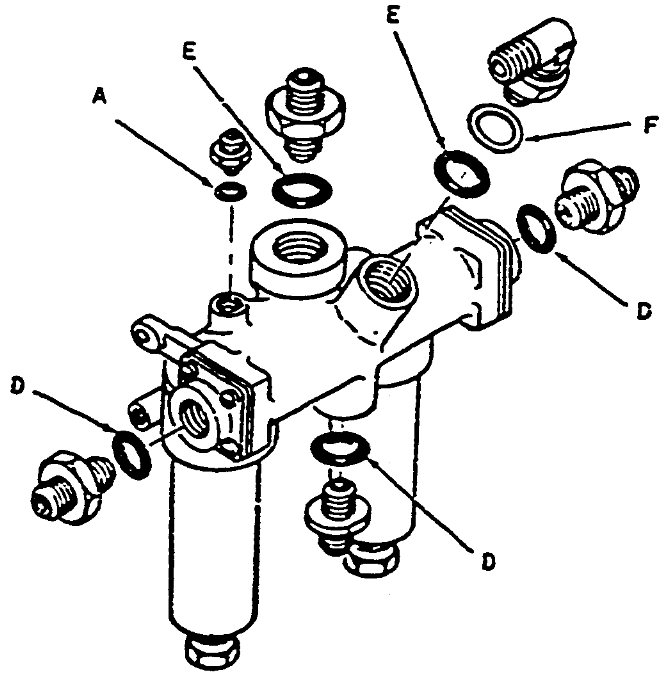
B-NAS 1612-5
C-NAS 1612-6
D-NAS 1612-8
E-NAS 1612-10
F-NAS 1612-12
G-NAS 1612-16
H-NAS 1611-110
J-NAS 1611-251
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

HA2-1677A

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



REGULATOR - ASPIRATOR
AND AIR FILTERS



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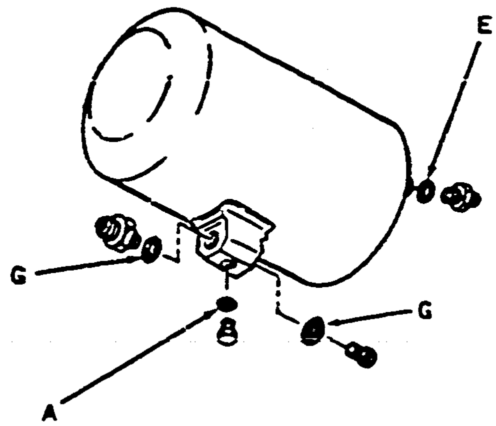
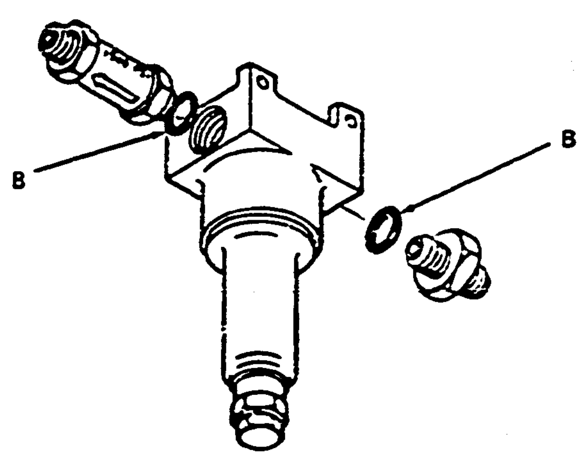
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



HYDRAULIC
PUMPCASE DRAIN
FILTER

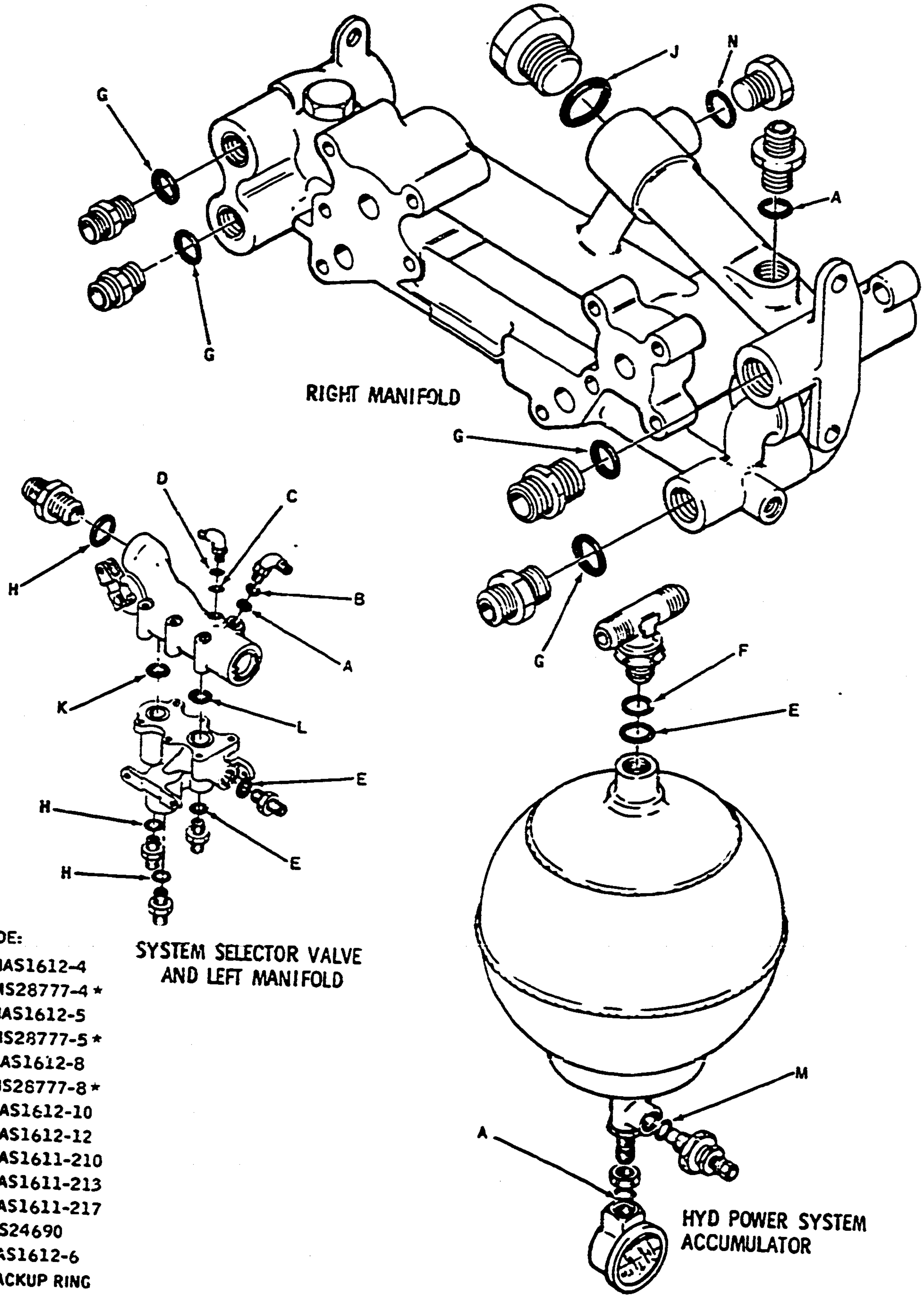
CODE

A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16

* - BACKUP RING

HA2-3415B

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 2)



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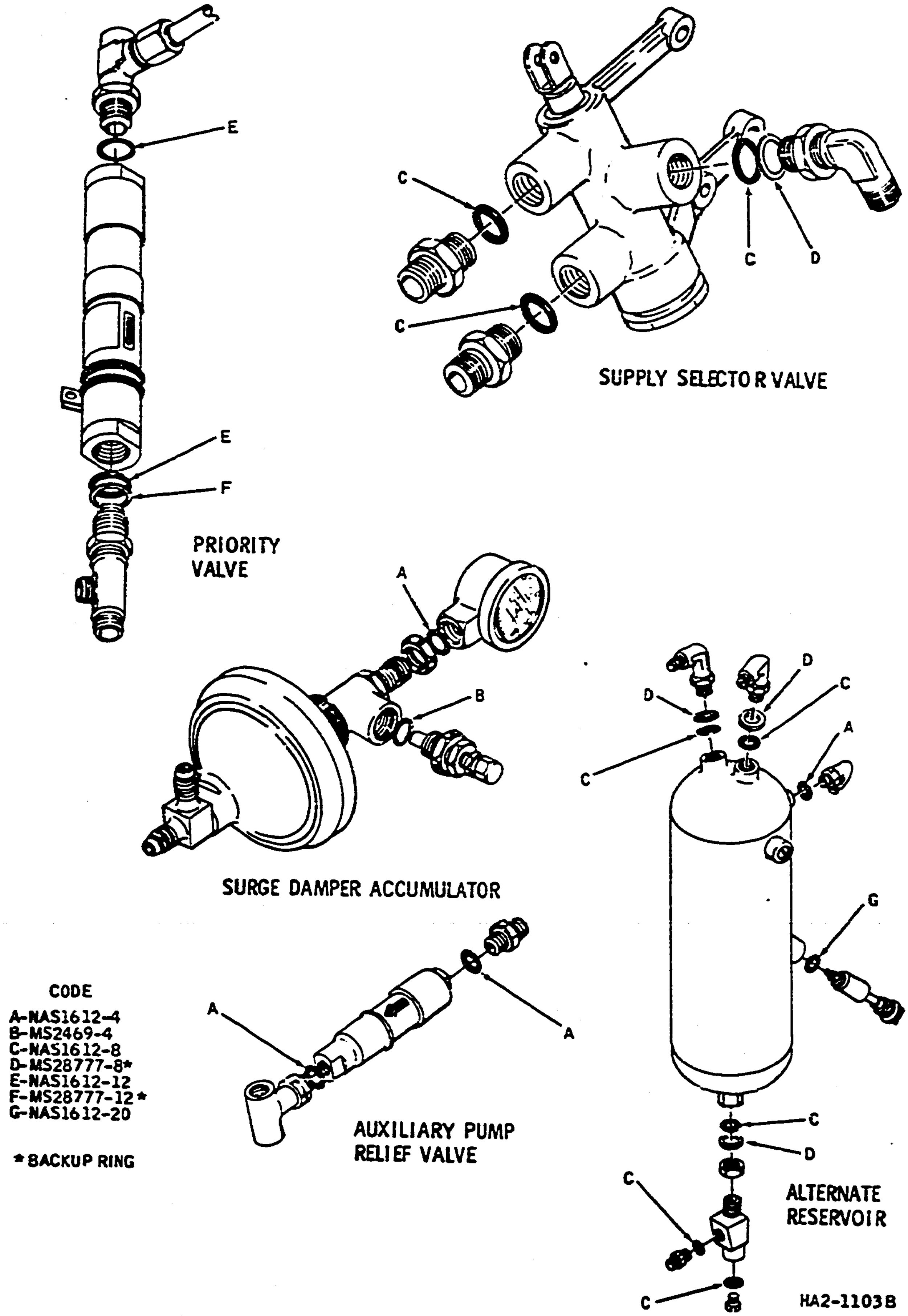
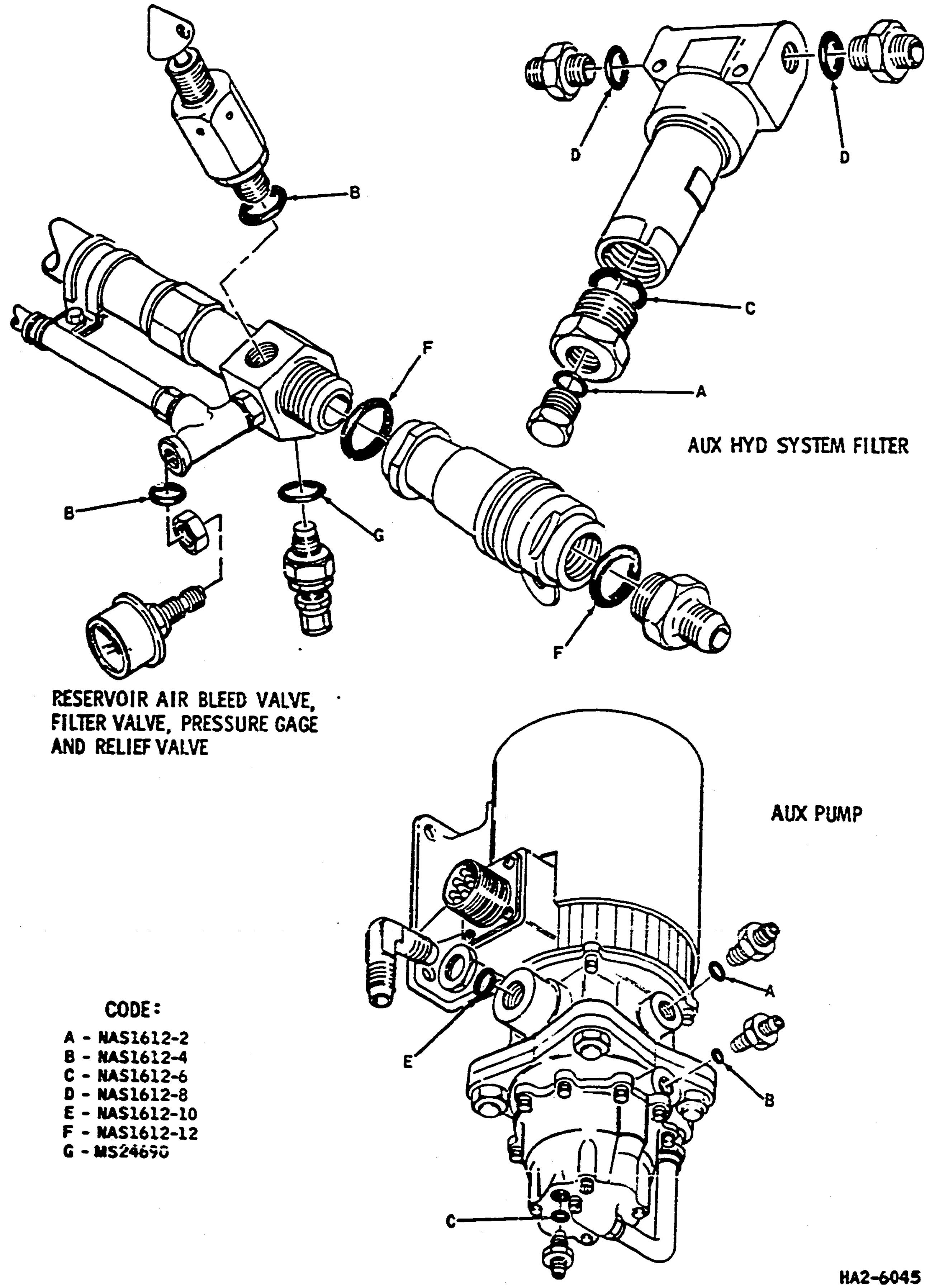
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

HA2-1678A

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 5)

(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System With Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flag control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System With Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handles agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve. and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button, hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed.

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valve in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 125 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off, and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) The thrust reverser system is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - MAINTENANCE PRACTICES

1. General

A. Skydrol Safety Precautions

(1) Before performing any operation on the hydraulic system, personnel should read and thoroughly understand the following precautions to be observed when working with Skydrol hydraulic fluid.

WARNING: OBSERVE THE FOLLOWING SAFETY PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. LONG EXPOSURE TO SKYDROL CAN CAUSE SKIN DEHYDRATION AND CHAPPING.

(2) Wash hands thoroughly with soap and water before starting work.

(3) Apply barrier cream to hands, wrists, and forearms. Rub cream under fingernails and into creases of skin.

(4) Wear goggles when pressure testing components or systems, and whenever there is any possibility of Skydrol splashing into eyes.

(5) If Skydrol splashes into eyes, treat eyes immediately by irrigating thoroughly with clear cold water, and report the incident.

(6) Wash hands, wrists, and forearms with soap and hot water whenever they have come in contact with Skydrol.

(7) If clothing becomes soaked with Skydrol; remove clothing as soon as possible, thoroughly wash skin, and put on clean clothing.

B. Technical Precautions

(1) Before any maintenance is performed on the hydraulic system, personnel should read and thoroughly understand the following precautions. Careful adherence to these instructions will aid in maintaining a functional and trouble-free system.

CAUTION: OBSERVE THE FOLLOWING TECHNICAL PRECAUTIONS WHEN WORKING ON THE HYDRAULIC SYSTEM. SKYDROL WILL ATTACK A WIDE RANGE OF MATERIALS INCLUDING RUBBER, COPPER, VARIOUS PLASTICS, AND PAINTS.

(2) Ensure that Skydrol does not come into contact with any part of aircraft outside of the hydraulic system. Keep spillage to an absolute minimum. Clean up spilled hydraulic fluid immediately to prevent entry into adjacent areas of the airplane precluding future false hydraulic leak reports. If spillage occurs, wipe up the fluid with a dry cloth and wash contaminated area with soap and hot water.

(3) When lines are disconnected and/or components are removed, provide suitable protection to prevent foreign material from entering the lines or components by use of caps, covers, clean lint-free rags, etc.

(4) When electrical connectors are disconnected, install caps or other suitable protectors to prevent entry of hydraulic fluid, moisture, and foreign objects.

(5) Always check position and angle of all fittings removed from components to ensure placement and alignment when installing replacement components.

(6) When washing metal parts before assembly, use only approved solvent, and ensure that all traces of the solvent are removed before assembly.

(7) Use only clean Skydrol for flushing or testing hydraulic components.

(8) Use only clean Skydrol when filling reservoirs, sumps, filter bowls, pumps, etc., before installation of components.

(9) Do not unpack Skydrol O-rings and seals until required. Ensure that only approved rings and seals are used.

(10) When assembling O-rings and seals, lubricate with Skydrol Assembly Lubricant, MCS 352, Monsanto Chemical Co., or clean Skydrol hydraulic fluid.

(11) Take care to prevent contamination of Skydrol with other materials (oils, water, dirt, etc.).

(12) If a system becomes contaminated with any petroleum-based oil or solvent, drain the system and flush with clean Skydrol.

C. Landing Gear Precautions

(1) The landing gear control lever should be in the down position and the landing gear ground lockpins should be installed in the main and nose gears at all times during ground maintenance, except as noted in maintenance procedural steps.

(2) The main gear wheels should be chocked at all times during ground maintenance, except as noted in maintenance procedural steps.

(3) The hydraulic system selector control lever should be in the general system (normal) position at all times during ground maintenance, except as noted in maintenance procedural steps.

D. Hydraulic Power System O-Rings

(1) O-rings used in the installation of hydraulic power system components are shown in Figure 201. O-rings required for the landing gear, power control systems, etc., will be found in the applicable chapters.

(2) O-ring part numbers shown in Figure 201 are interchangeable with Douglas standard (S-XXXXXXXX) numbers listed in the Illustrated Parts Catalog and on engineering drawings.

2. Pressurize/Depressurize Hydraulic System

A. Pressurize Hydraulic System with External Hydraulic Source Pressure

(1) Tools and Equipment Required: A hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm at 3000 psi, using Skydrol hydraulic fluid. The maximum permissible operating temperature should not exceed 180°F (82.2°C).

(2) Make certain that landing gear control lever is in down position and ground lockpins installed.

(3) Make certain that wing flap control handle agrees with wing flap position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Remove dust caps from airplane ground service connections and connect test stand pressure and supply hoses.

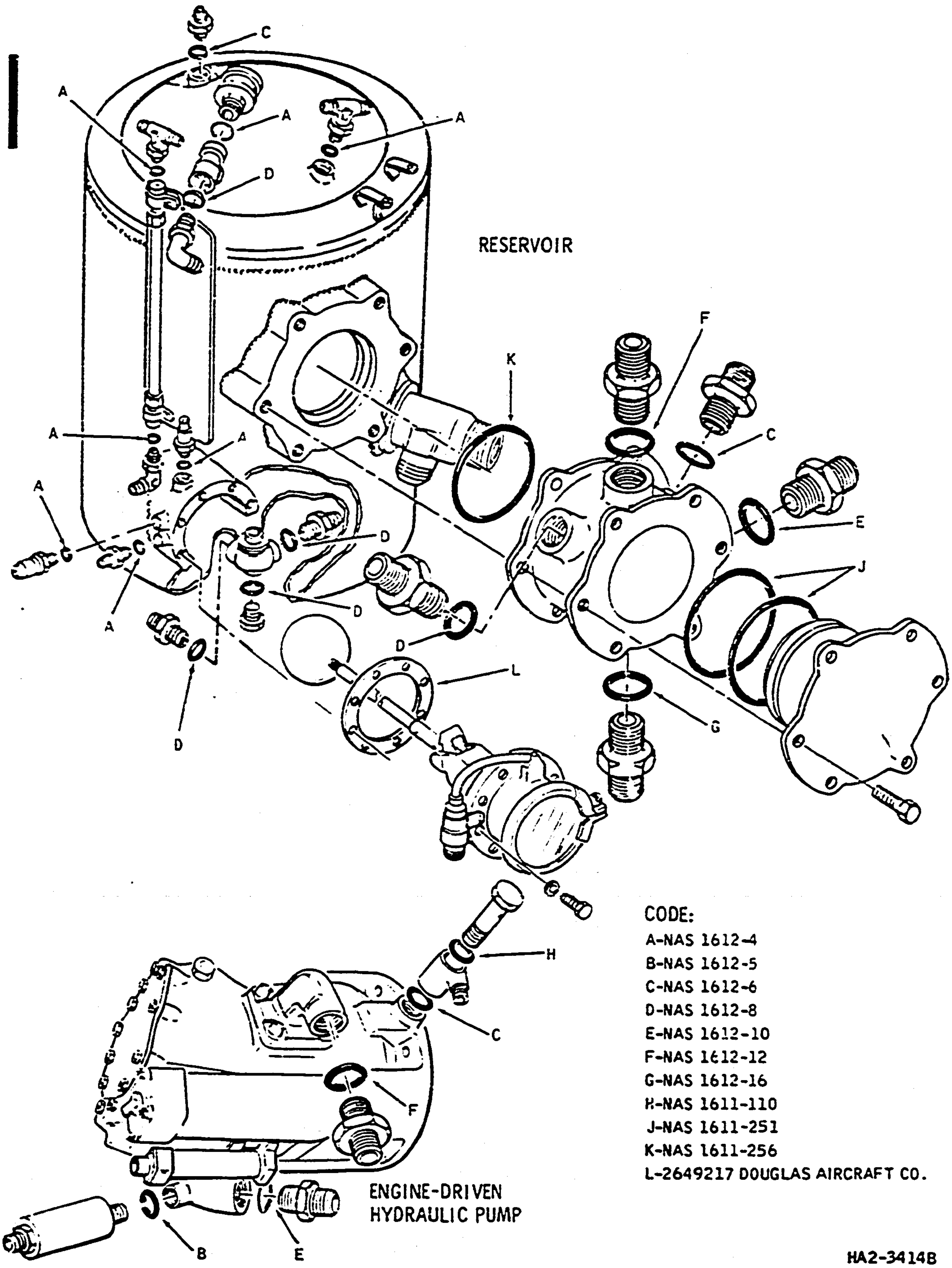
(6) Energize test stand hydraulic pump; pressurize hydraulic system to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

B. Depressurize and Disconnect

(1) Check hydraulic fluid level of hydraulic reservoir; fill if necessary as described on instruction placard on reservoir.

(2) Deenergize test stand hydraulic pump.



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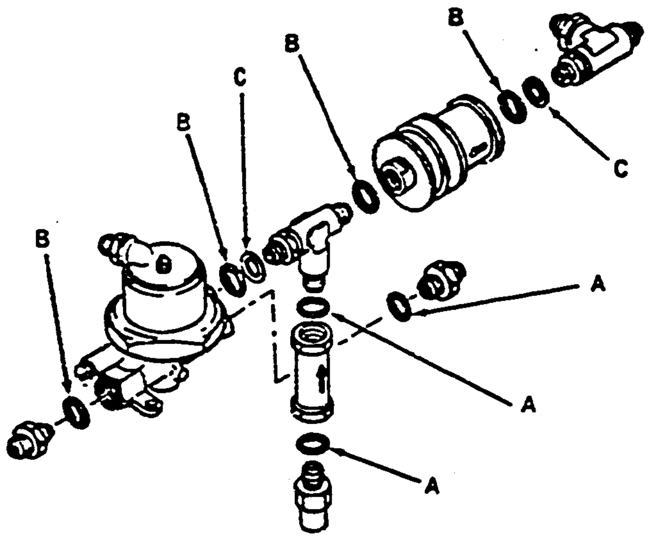
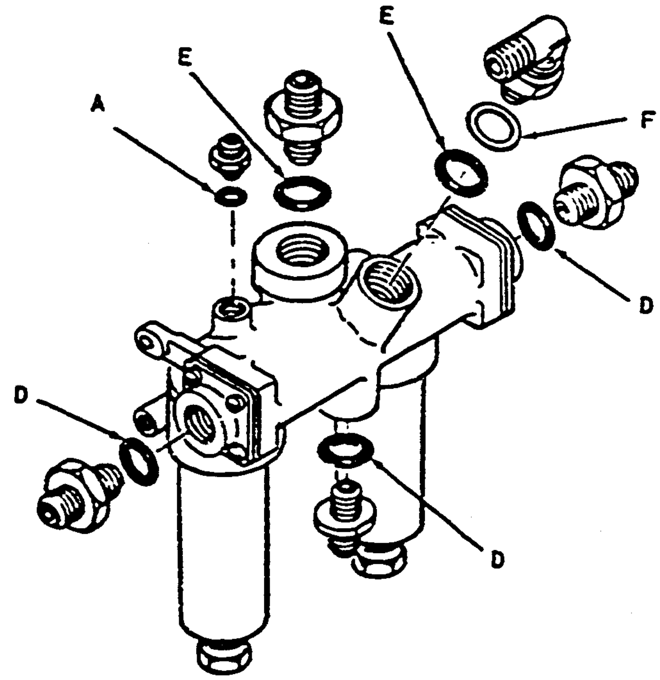
G-NAS 1612-16
H-NAS 1611-110
J-NAS 1611-251
K-NAS 1611-256
L-2649217 DOUGLAS AIRCRAFT CO.

HA2-34148

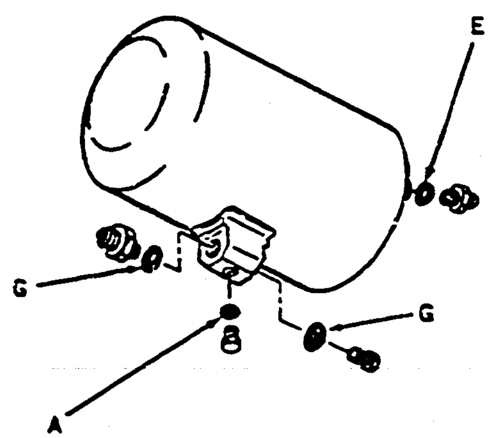
Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 1)



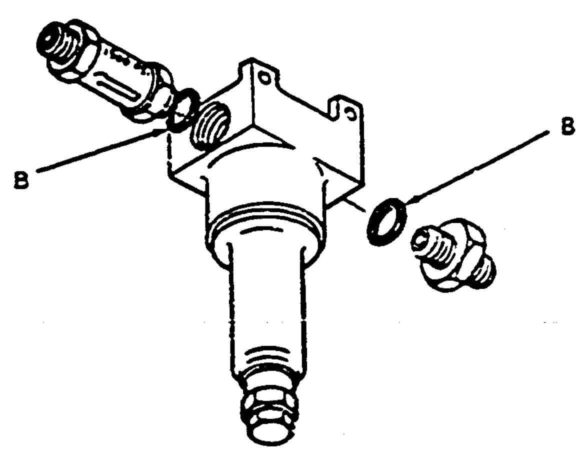
REGULATOR - ASPIRATOR
AND AIR FILTERS



DUAL-FILTER &
RELIEF VALVE



HYDRAULIC RESERVOIR
AIR CHAMBER



HYDRAULIC
PUMPCASE DRAIN
FILTER

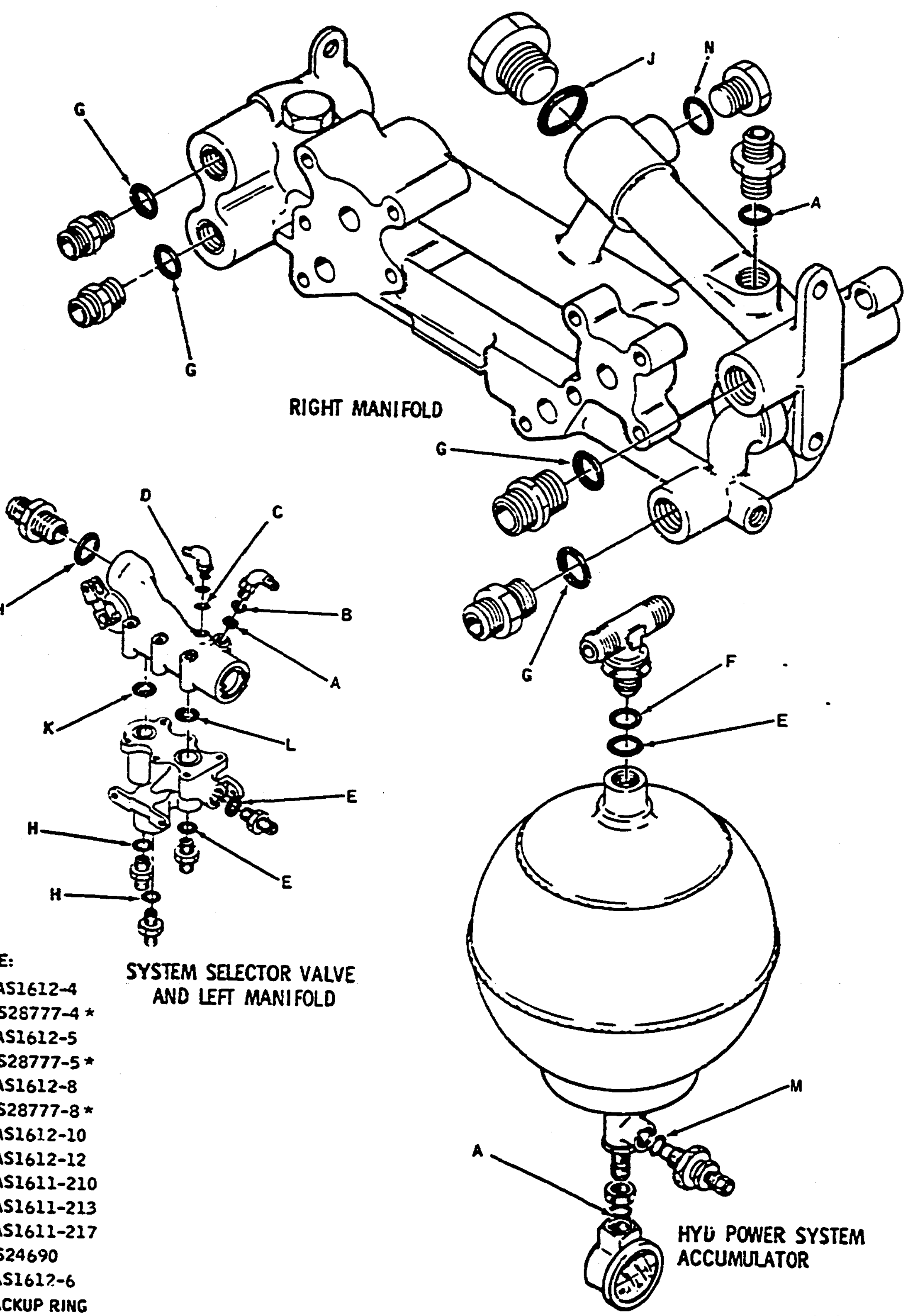
CODE

A - NAS1612-4
B - NAS1612-6
C - MS28777-6 *
D - NAS1612-10
E - NAS1612-12
F - MS28777-12 *
G - NAS1612-16

* - BACKUP RING

HA2-34158

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 2)



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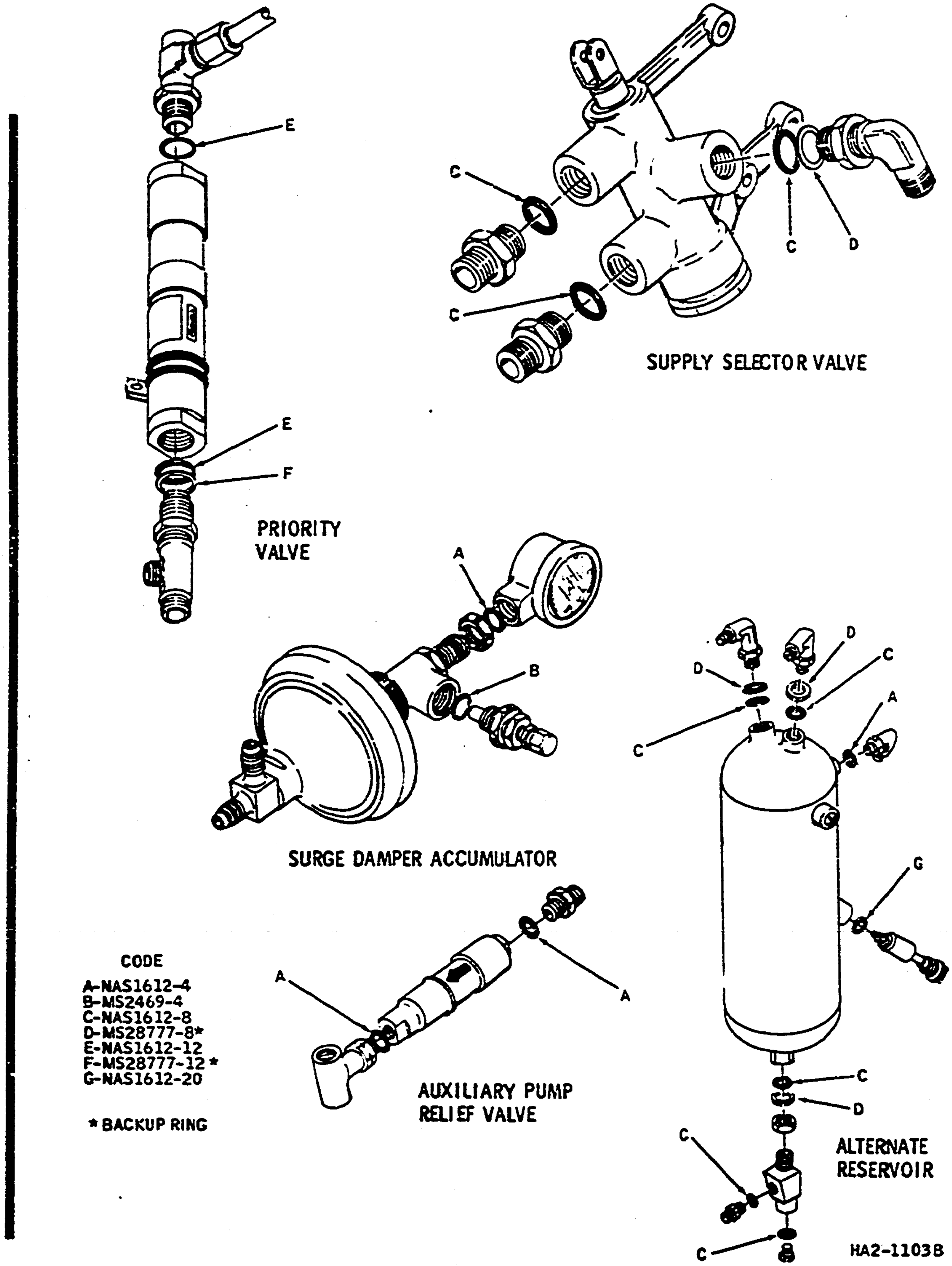
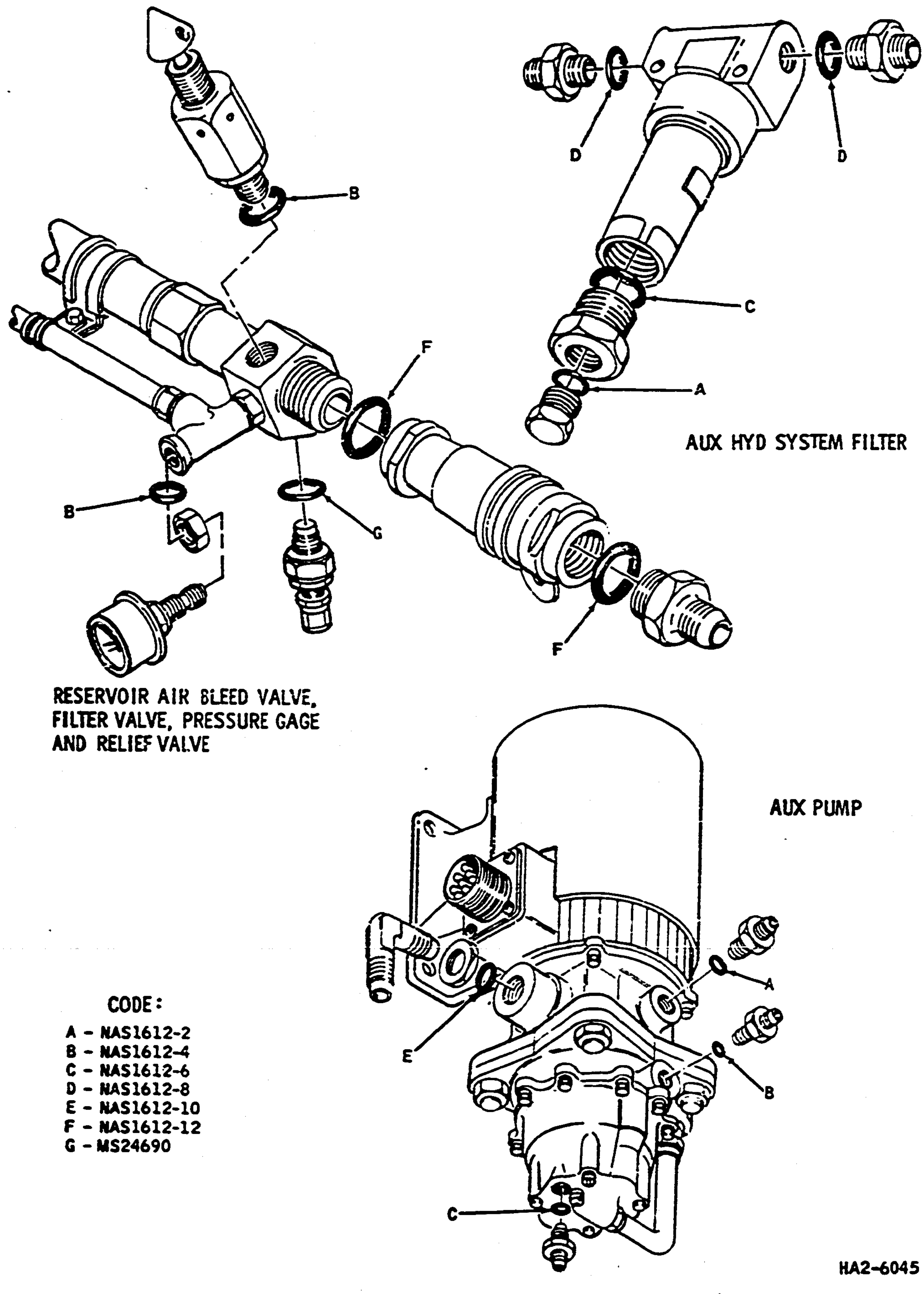
B-MS28777-4 *
C-NAS1612-5
D-MS28777-5 *
E-NAS1612-8
F-MS28777-8 *
G-NAS1612-10
H-NAS1612-12
J-NAS1611-210
K-NAS1611-213
L-NAS1611-217
M-MS24690
N-NAS1612-6
*-BACKUP RING

HA2-1678A

Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 3)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 4)



Hydraulic Power System Components -- O-Rings
Figure 201 (Sheet 5)

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(3) Depressurize hydraulic system by operating the brakes and manually moving the longitudinal trim handle until horizontal stabilizer movement stops.

(4) Disconnect and cap test stand pressure and supply hoses from airplane ground service connections; install duct caps on connections and close access door.

C. Pressurize Hydraulic System with Auxiliary Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap control handle agrees with wing flap position.

(3) Place hydraulic system selector control lever in general system/bypass position.

(4) Check that airplane electrical buses are energized (see Chapter 24).

(5) Start auxiliary hydraulic pump by placing auxiliary hydraulic pump control switch momentarily in start position. Pressure indicated in the flight compartment should be 2600 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD THE AUXILIARY HYDRAULIC PUMP CONTROL SWITCH IN THE START (HOLD ONLY IN EMERGENCY) POSITION FOR NORMAL PRESSURIZATION.

D. Depressurize

(1) Stop auxiliary hydraulic by placing auxiliary hydraulic pump control switch momentarily in stop position.

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

(3) Place hydraulic system selector control lever in general system (normal) position.

E. Pressurize Hydraulic System with Engine-Driven Hydraulic Pump Pressure

(1) Make certain that landing gear control lever is in down position and ground lockpins installed.

(2) Make certain that wing flap handle agrees with wing flap position.

(3) Make certain that applicable fire control handle is in normal position.

(4) Place hydraulic system selector control lever in general system (normal) position.

(5) Make certain that applicable engine-driven hydraulic pump control switch is in on position.

(6) Start engine No. 2 or No. 3 (see Chapter 71). Hydraulic pressure indicated in the flight compartment should be 2800 to 3000 psi.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

F. Depressurize

(1) Shut down engine (see Chapter 71).

(2) Depressurize hydraulic system by operating brakes and manually moving longitudinal trim handle until horizontal stabilizer movement stops.

3. Pressurize/Depressurize Hydraulic Reservoir

A. General

(1) The air inflation valve, air bleed valve, and air pressure gage for manually pressurizing and depressurizing the hydraulic reservoir and air chamber are located on the aft side of the wing rear spar, at the forward end of the left main gear wheel well. The valves and gage are mounted on a cross fitting just inboard of the reservoir air chamber. Access is through the left main gear inboard door.

B. Tools and Equipment Required

(1) Pressure cylinder (clean dry compressed air or nitrogen).

C. Pressurize Hydraulic Reservoir

NOTE: Normal air pressure in the reservoir and air chamber should be between 30 and 35 psi.

NOTE: There are three methods of pressurizing the hydraulic reservoir:

(1) Run an inboard engine.

(2) Connect and operate a hydraulic test stand.

(3) Direct pressurization of air chamber by introduction of compressed air or nitrogen.

The first two methods are automatic in that the reservoir is pressurized by action of the hydraulic fluid through the regulator-aspirator when the system is pressurized. The third method (direct inflation) will be described in the following steps.

(1) Remove air inflation valve cap and attach pressure cylinder service hose to inflation valve.

(2) Loosen inflation valve swivel nut three complete turns.

NOTE: The rate of inflation (flow through the valve) is governed by the degree of opening of the swivel valve.

(3) Pressurize reservoir to 30 to 35 psi reading on air pressure gage.

(4) Tighten swivel nut.

(5) Disconnect service hose and install valve cap.

CAUTION: THE AIR INFLATION VALVE IS A STANDARD "AN" VALVE WHICH HAS BEEN MODIFIED BY INSTALLATION OF SKYDROL TYPE SEALS. DO NOT REPLACE THE VALVE WITH A VALVE WHICH HAS NOT BEEN MODIFIED FOR SKYDROL.

D. Depressurize Hydraulic Reservoir

(1) Depress air bleed valve button; hold until all pressure has bled off and pressure gage reads zero.

4. Drain Hydraulic System Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 20 US gallons (16.65 Imperial gallons or 75.7 liters) capacity.

B. Drain Reservoir

(1) Depressurize hydraulic system and reservoir (see paragraphs 2 and 3).

(2) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(3) Remove drain unit, and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

5. Drain Auxiliary Hydraulic Pump Alternate Reservoir

A. Tools and Equipment Required

(1) Drain unit consisting of one 3/8-inch bulkhead fitting with a suitable length of flexible hose attached.

(2) Clean container of approximately 3 US gallons (2.5 Imperial gallons or 11.5 liters) capacity.

B. Drain Reservoir

(1) Remove self-sealing magnetic drain plug from manifold at base of reservoir. Insert drain unit into plug port, and drain fluid from reservoir into clean container.

(2) Remove drain unit and install magnetic drain plug. Tighten magnetic drain plug to torque of 312 (±20) inch-pounds. Safety with lockwire.

6. Hydraulic System Pressure Decay Rates

A. Decay Rate Test

(1) By observing the time it takes for the hydraulic system pressure of 2900 (±100) psi to decrease 1000 psi, it is possible, in most cases, to detect units that are leaking excessively. This procedure is not infallible because the sum of the maximum allowable leakage rates determines the minimum time permissible for pressure decay. The hydraulic system with average leakage will maintain pressure for longer periods than indicated and may do so even with one unit leaking excessively.

(2) The main hydraulic system should be tested for pressure decay time under the following conditions:

(a) System selector valve in general system/bypass or general system (normal).

(b) Nosewheel straight ahead plus or minus 30 degrees and steering valve in neutral position.

(c) Manual main gear door valve open.

(d) Landing gear down and locked.

(e) Wing flaps up.

(f) Accumulators properly charged.

(g) Aileron shutoff valve off.

(h) Rudder shutoff valve off.

(i) Thrust reversers stowed.

(3) Pressurize main hydraulic system to 2900 (±100) psi with auxiliary pump or hydraulic test stand. Then shut off hydraulic power source and note time interval required for system pressure to decrease 1000 psi. This should be more than 34 seconds on a new airplane or more than 23 seconds on an airplane in service before overhaul. If pressure decay time is less, the main hydraulic system should be inspected for a malfunctioning unit.

(4) If pressure decay test indicates that a unit in the main hydraulic system was leaking excessively, that unit may be in the nose or main gear subsystem, the main gear door subsystem, the flap subsystem, the slot subsystem, the selector valve, or the compressor subsystem. By placing the subsystem control valves in opposite positions one at a time and repeating the pressure decay test, it is possible that the faulty unit may be located.

(5) Rudder power hydraulic system may be tested for pressure decay time by using procedures outlined in steps (2) and (3), except that the rudder shutoff valve should be on. Decay time should be more than 10 seconds on a new airplane or more than 8 seconds on an airplane in service before overhaul. If less, the rudder power system should be inspected for a malfunctioning unit.

(6) Supplementary information may be obtained for the rudder power hydraulic system by using the auxiliary rudder system pump and accumulator air gage to test the time for rudder pressure of 2900 (±100) psi to decrease 1000 psi. With the rudder hydraulic power shutoff valve off, the time should be more than 2 minutes. With the rudder hydraulic power shutoff valve on, the time should be 12 seconds on a new airplane and 10 seconds on an airplane in service before overhaul.

(7) Aileron hydraulic power system may be tested for pressure decay by using procedures outlined in steps (2) and (3), except that the aileron hydraulic power shutoff valve should be on. The decay time should be more than 6-1/2 seconds on a new airplane or more than 4-1/2 seconds on an airplane in service before overhaul. If less, the aileron power system should be inspected for a malfunctioning unit.

(8) Brake system and the nose gear steering system are isolated from the main hydraulic system by check valves and may be tested separately. Using the brake accumulator gages, the pressure decay time for the brake system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 10 hours with the parking brake off, and 2 hours with the parking brake on. With the brake accumulators fully charged deplete the general system pressure. Wait 3 to 5 minutes and then set the parking brake and hold the parking brake pressure for 15 minutes. The drop in pressure at the brake accumulators should not exceed 124 psi during this time.

(9) Release the parking brakes, and build up brake accumulator pressure to 2900 (±100) psi. With hydraulic power off, and brakes off, check brake accumulator pressure. Drop in pressure at the accumulators should not exceed 100 psi in 30 minutes. Fast decay time for the brake system with parking brake off, indicates either a faulty brake valve or a faulty check valve in the right manifold. A fast decay time with the parking brake on indicates a faulty antiskid valve or a faulty brake valve.

(10) Using the gages on the nose pressure accumulators, the time for the nose gear steering system pressure of 2900 (±100) psi to decrease 1000 psi should be more than 19 minutes. If less, one of the pressure check valves is faulty, or the nose gear steering control valve is faulty or out of neutral.

CAUTION: ALL LANDING GEAR GROUND LOCKPINS MUST BE INSTALLED BEFORE CONDUCTING THE FOLLOWING TEST.

(11) Under conditions outlined in step (2), except with the landing gear control valve in the up position, the time for pressure decay should be unchanged. If time limits change more than 5 seconds as determined in paragraph (3), a faulty unit is in the gear subsystem.

(12) Under conditions outlined in step (2), except with the main gear door manual control valve in the closed position, the decay time should be more than 24 seconds on a new airplane and 18 seconds on an airplane in service before overhaul. If less, the faulty unit is in the main gear door subsystem.

(13) Under conditions outlined in step (2), except with the flap control valve in the down position, the decay time should be more than 24 seconds on a new airplane and 17 seconds on an airplane in service before overhaul. If less, the faulty unit is in the flap subsystem.

(14) Under conditions outlined in step (2), time limit for pressure decay should remain unchanged as determined in paragraph (3) with the slot valve in either position, or the selector valve in either general system/bypass or general system (normal). If the time changes with a change of valve position, the faulty unit is in that subsystem.

(15) The thrust reverser system is isolated from the main system by an electrically operated shutoff valve which is open only during thrust reverser actuation. Therefore, main system decay is not affected by the thrust reverser system except during reverser actuation or at the thrust reverser extended position. Additional information may be obtained for the thrust reverser system by using the auxiliary reverser system pump and reverser system pressure gage or accumulator gage to test the time for reverser pressure of 2900 (±100) psi to decrease 1000 psi. With the reversers in the stowed position, the decay time should be greater than 3 minutes on a new aircraft or greater than 1-1/2 minutes on an aircraft in service before overhaul. If times are less, the reverser system should be inspected for a malfunction.

GENERAL - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the DC-8 hydraulic systems by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. The DC-8 is provided with a main, a spoiler, and two auxiliary hydraulic systems. The auxiliary systems consist of the main auxiliary system, and the rudder standby system. All of these systems are subject to contamination which must be removed.

E. Contamination in the hydraulic sense may consist of foreign particles (metal, rubber, plastic, dirt, etc.), fluids other than hydraulic fluid, and damaged hydraulic fluid, which because of excessive heat and friction, no longer meets the minimum requirements.

F. The system filters ordinarily remove the minor contamination associated with normal wear. These filter elements are replaced at periodic inspections.

G. Contamination which requires a system or subsystem to be flushed is usually the result of:

(1) A damaged unit such as a pump failure.

(2) A malfunctioning unit or system, the nature of which lends suspicion to possibly contaminated fluid.

(3) Overheated or diluted fluid, which does not meet minimum specification requirements.

H. The presence of contamination may be determined by:

(1) Checking the filter elements and bowls.

(2) Checking the magnetic drain plugs in the reservoirs and filters.

(3) Checking the fluid in the reservoirs.

(4) Taking samples of the fluid at various locations.

(5) Checking the individual components.

2. Isolation

A. The hydraulic subsystems may be isolated as follows:

(1) The main hydraulic power system is physically separated from the lateral control spoiler system.

(2) The lateral control spoiler system pump and supply is separated from the remainder of the lateral control system by a filter.

(3) The main hydraulic power system engine-driven hydraulic pumps are separated from the main system by the dual filter and relief valve assembly.

(4) The auxiliary hydraulic pump is separated from the main system by the auxiliary hydraulic pump filter.

(5) The aileron control valves and actuating cylinders are isolated from the main hydraulic power system by the aileron line filters.

(6) The empennage hydraulic power system is separated from the main hydraulic power system by the rudder filter.

(7) The filter in the main hydraulic system reservoir filters all returning fluid.

(8) A filter is installed in the engine-driven hydraulic pump low-pressure (case drain) return line to separate the pump return fluid from the main hydraulic system fluid.

(9) The rudder standby hydraulic system is separated from the main hydraulic power system by a filter and interconnect line.

(10) In addition to the filter divisions, the subsystems have been broken down into distribution and utility runs for ease of flushing and for isolation in specific cases where a known contamination source exists.

3. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

4. Flush Main Hydraulic Power System (Normal and Auxiliary)

A. Pressure Lines (Engine-Driven Pumps to Dual Filter and Relief Valve)

(1) Disconnect engine-driven hydraulic pump pressure hose from pump in Number 3 pylon.

(2) Disconnect pressure line from right side of dual filter and relief valve, located in left main gear wheel well.

(3) At Number 3 pylon, replace check valve, located between engine pump hose and pressure line, with bulkhead fitting.

(4) Connect engine pump pressure hose to test stand pressure hose, and connect disconnected line at dual filter to test stand return hose.

(5) Pressurize test stand to 200 psi at 5 to 20 gpm fluid flow.

(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Repeat Steps (1) through (7) for pressure line between dual filter and Number 2 engine pump.

(9) Remove dual filter and relief valve filter elements, clean filter bowls, and install clean filter elements (see 29-10-17).

(10) Inspect, clean, and/or replace check valves.

(11) Restore all lines and units to original configuration.

B. Case Drain Lines (Airplanes 801-811.)

(1) Disconnect case drain hose from engine-driven pump on Number 3 engine, and connect this hose to test stand pressure hose.

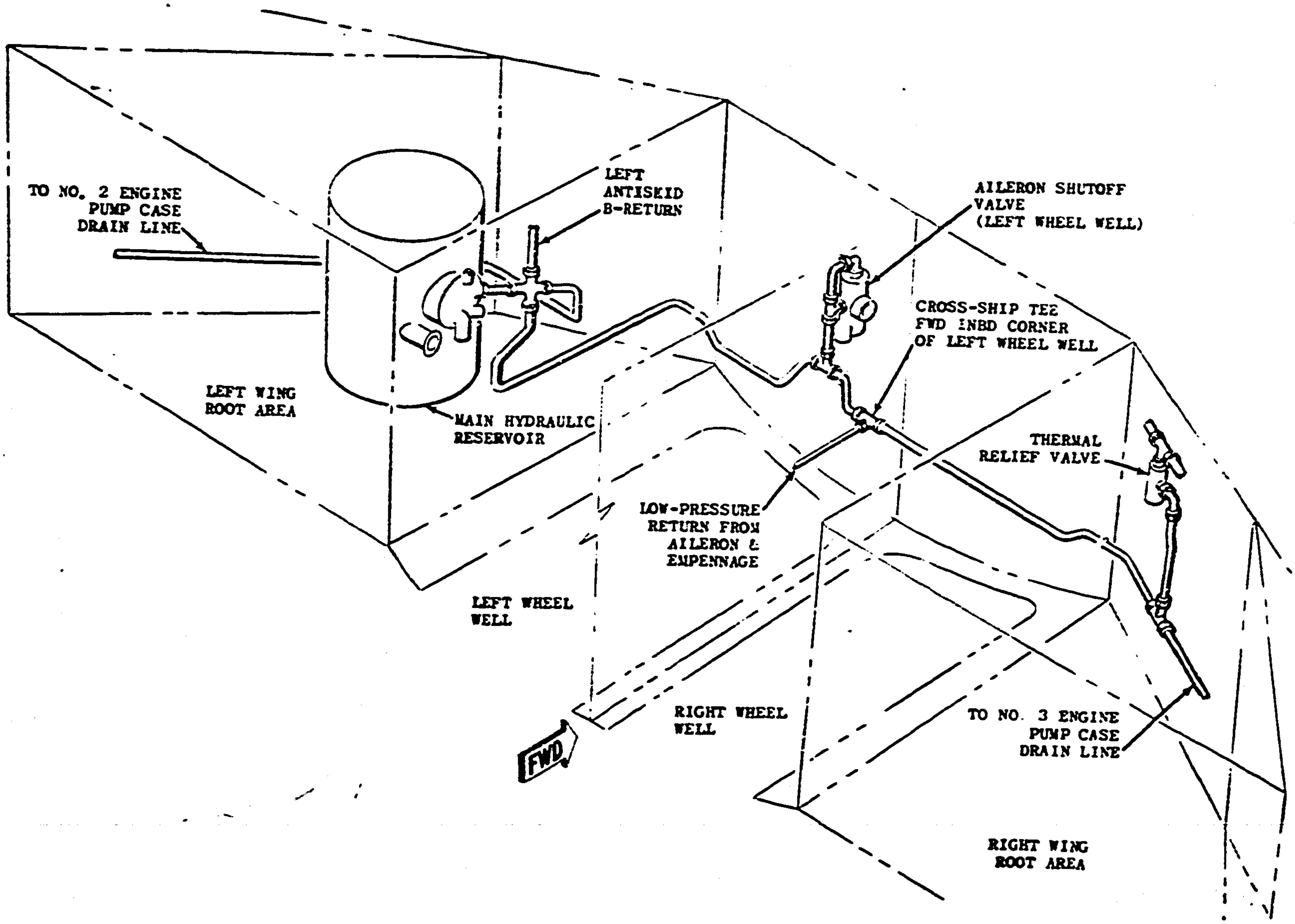
(2) At Number 3 pylon replace check valve, located between case drain hose and case drain line with bulkhead fitting.

(3) Disconnect aileron shutoff valve low-pressure line from tee fitting in case drain line located above inboard side of dual filter and relief valve (see Figure 601). Cap tee.

(4) Disconnect empennage low-pressure return line from case drain line tee fitting, located inboard of tee mentioned in Step (3). Cap tee.

(5) Disconnect wing flap thermal relief valve low-pressure return line from tee in case drain line. Cap tee.

(6) Disconnect Number 2 engine pump case drain line from tee fitting at reservoir. Cap fitting.



H2-5497

Flushing Procedure Line Connection Locations
(Airplanes 801-811)
Figure 601

(7) Disconnect case drain line from low-pressure return port in reservoir. Connect test stand return hose to this line. Cap reservoir port.

(8) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(9) Flush circuit for five minutes.

(10) Depressurize test stand.

(11) Repeat Steps (1) and (2) for Number 2 engine-driven pump.

(12) Connect Number 2 engine pump case drain line, which was disconnected and capped in Step (6), to hydraulic test stand return hose.

(13) Repeat Steps (8) through (10) for this circuit.

(14) Inspect, clean, and/or replace check valves.

(15) Restore all lines and units to original configuration.

C. Case Drain Lines (Airplanes 812-822.)

(1) Disconnect case drain hose from engine-driven pump in Number 3 pylon. Connect hose to hydraulic test stand pressure hose.

(2) At Number 3 pylon, replace check valve between engine-driven pump hose and case drain line with bulkhead fitting.

(3) At tee fitting, located in low-pressure return line adjacent to reservoir return port (see Figure 602), disconnect Number 2 engine pump case drain line. Cap tee fitting.

(4) Disconnect case drain line from low-pressure return port in reservoir, and connect this line to test stand return hose. Cap reservoir port.

(5) Disconnect lines from both sides of case drain filter and check valve, and jumper these return lines.

(6) Pressurize test stand to 200 psi maximum, at 20 gpm flow.

(7) Flush circuit for five minutes.

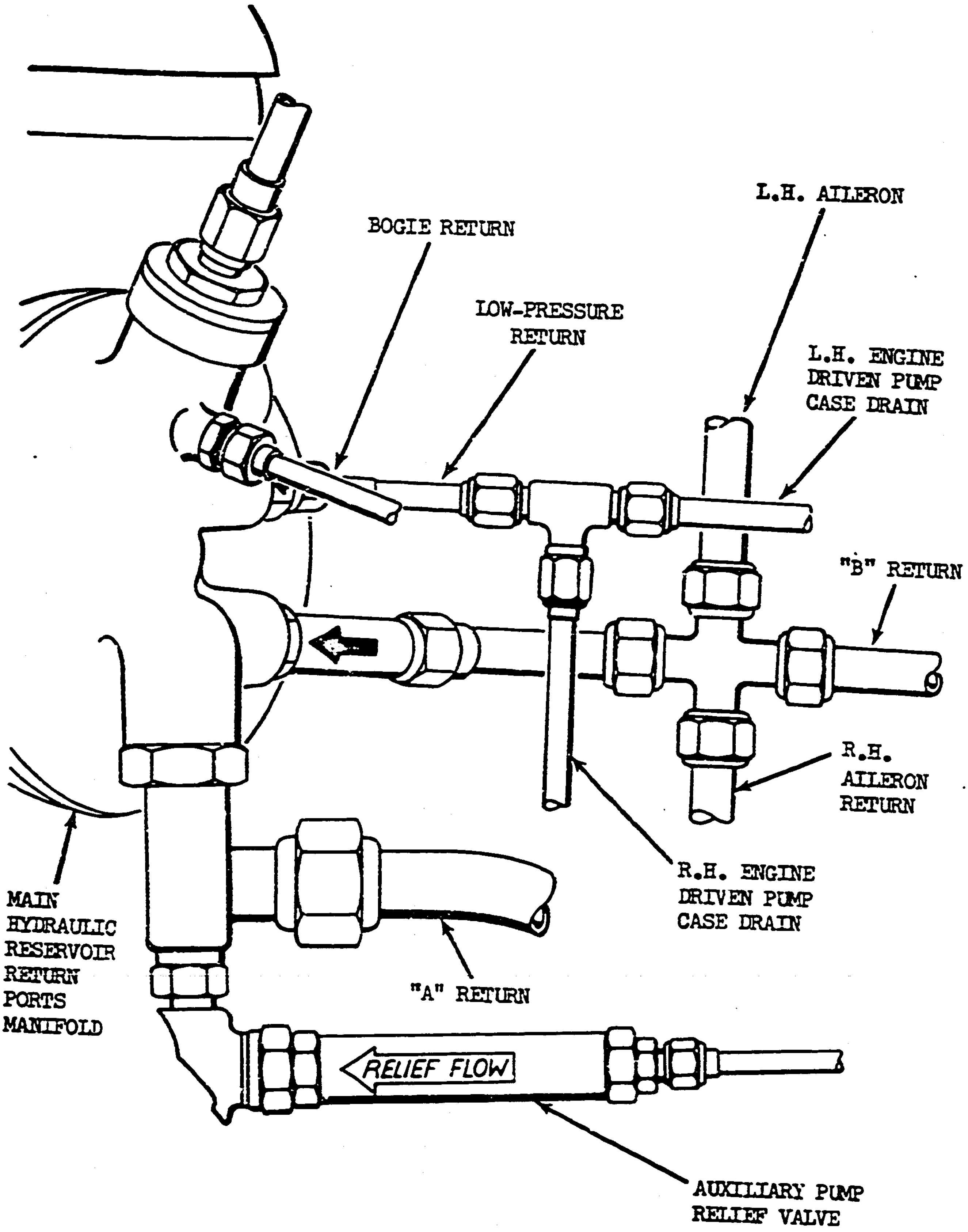
(8) Depressurize test stand.

(9) Repeat Steps (1) and (2) for engine-driven pump in Number 2 pylon.

(10) Connect Number 2 engine pump case drain line, which was disconnected in Step (3), to hydraulic test stand return hose.

(11) Repeat Step (5) for Number 2 engine case drain filter and check valve.

(12) Repeat Steps (6), (7), and (8) for Number 2 engine pump case drain lines.



Flushing Procedure Line Connection Locations
(Airplanes 812-822)
Figure 602

H2-5496

(13) Clean filter bowls and replace filter elements in case drain filters, located on rear spar (see 29-10-15).

(14) Inspect, clean, and/or replace check valves.

(15) Restore all lines and units to original configuration.

D. Reservoir and Suction System (Airplanes 801-811.)

(1) Do not remove large reducer tee fitting and connecting supply lines from reservoir (see Figure 603).

(2) Connect hydraulic test stand return hose to airplane ground service supply connection.

(3) Drain reservoir, remove reservoir filter element (see 29-10-2), and clean out reservoir.

(4) Temporarily install reservoir filter cover plate with all return ports plugged except for 60 psi relief valve on A-return port.

(5) Disconnect aspirator line at reservoir end. Cap reservoir end and cap reservoir port.

(6) Open fire shutoff valve on Number 2 engine.

(7) Disconnect suction hose from Number 2 engine-driven pump.

(8) Connect test stand pressure hose to suction hose removed in Step (7).

(9) Pressurize test stand to 45 psi at 20 gpm flow.

(10) Flush from engine pump suction hose to reservoir for five minutes.

CAUTION: WHEN FLUSHING THE SUPPLY LINES, MONITOR THE RESERVOIR FLUID LEVEL AND THE AIR PRESSURE GAGE ON TOP OF THE RESERVOIR AIR BLEED VALVE. THE FLUID LEVEL MUST BE VISIBLE IN THE SIGHT GAGE, AND THE PRESSURE MUST NOT EXCEED 45 PSI TO PREVENT DAMAGE TO THE RESERVOIR.

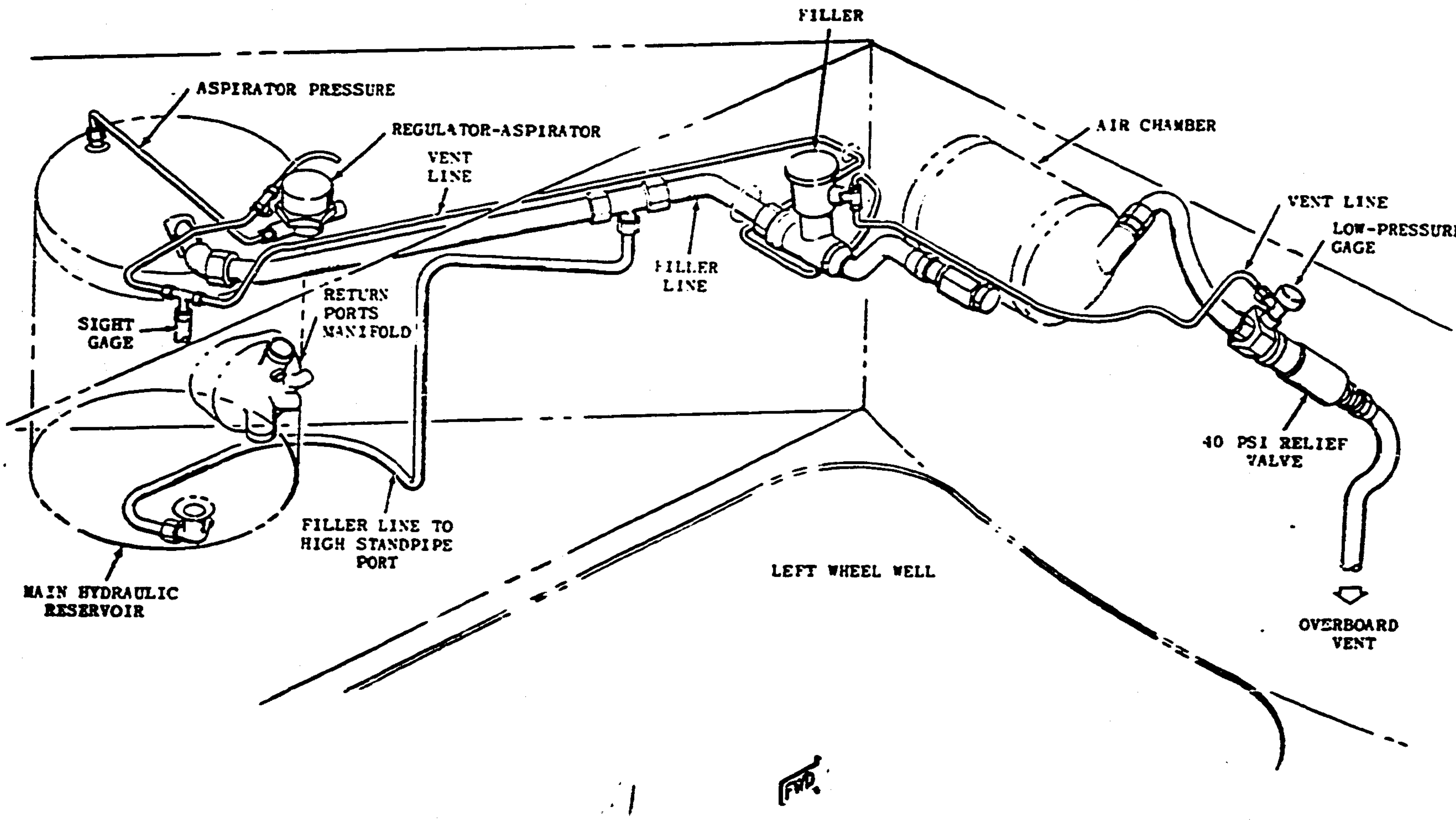
(11) Depressurize test stand.

(12) Close Number 2 engine fire shutoff valve, and open Number 3 engine fire shutoff valve.

(13) Remove test stand pressure hose from Number 2 engine pump supply line, and connect it to Number 3 engine-driven pump supply line.

(14) Repeat Steps (9) through (11).

(15) Disconnect test stand from engine-driven pump supply hose, and close Number 3 engine fire shutoff valve.



H2-5041

Flushing Procedure Line Connection Locations
Figure 603

(16) Uncap aspirator line and reservoir aspirator port. Connect aspirator line to reservoir.

(17) Flush reservoir, air chamber, and associated lines as follows:

(a) Disconnect line which runs from air chamber to reservoir air relief valve, located downstream of air bleed valve in left wheel well.

(b) Connect this line to test stand pressure hose.

(c) At this same location, disconnect vent line which runs to tee fitting in reservoir filler neck. Cap line.

(d) At filler neck, disconnect both vent lines and connect them together with jumper line.

(e) At tee in filler line, disconnect line which runs to high standpipe port at bottom of main reservoir. Cap tee fitting, and connect disconnected line to test stand return hose.

(f) Pressurize test stand to 45 psi maximum at 20 gpm flow.

(g) Flush circuit for five minutes.

(18) Depressurize test stand.

(19) Disconnect test stand pressure hose from overboard line, and cap this line. Connect test stand pressure hose to vent line that was capped in Step (17, c).

(20) Repeat Steps (17, f and g).

(21) Depressurize test stand, drain and clean out reservoir. Install new reservoir filter element (see 29-10-2).

(22) Restore all lines and units to original configuration.

E. Reservoir and Suction System (Airplanes 812-822.)

(1) Do not remove large reducer tee fitting and connecting supply lines from reservoir (see Figure 603).

(2) Connect hydraulic test stand return hose to airplane ground service supply connection.

(3) Drain reservoir, remove reservoir filter element (see 29-10-2). Clean out reservoir.

(4) Temporarily install reservoir filter cover plate with all return ports plugged.

(5) Disconnect aspirator line at reservoir end. Cap reservoir end and cap reservoir port.

(6) Open fire shutoff valve on Number 2 engine.

(7) Disconnect suction hose from Number 2 engine-driven pump.

(8) Connect test stand pressure hose to suction hose removed in Step (7).

(9) Pressurize test stand to 45 psi at 20 gpm flow.

(10) Flush from engine pump suction hose to reservoir for five minutes.

<u>CAUTION</u>: WHEN FLUSHING THE SUPPLY LINES, MONITOR THE RESERVOIR FLUID LEVEL AND THE AIR PRESSURE GAGE ON TOP OF THE RESERVOIR AIR BLEED VALVE. THE FLUID LEVEL MUST BE VISIBLE IN THE SIGHT GAGE, AND THE PRESSURE MUST NOT EXCEED 45 PSI TO PREVENT DAMAGE TO THE RESERVOIR.

(11) Depressurize test stand.

(12) Close Number 2 engine fire shutoff valve, and open Number 3 engine fire shutoff valve.

(13) Remove test stand pressure hose from Number 2 engine pump supply line, and connect to Number 3 engine-driven pump supply line.

(14) Repeat Steps (9) through (11).

(15) Disconnect test stand from engine-driven pump supply hose, and close Number 3 engine fire shutoff valve.

(16) Uncap aspirator line and reservoir aspirator port. Connect aspirator line to reservoir.

(17) Flush reservoir, air chamber, and associated lines as follows:

(a) Disconnect line which runs from air chamber to reservoir air relief valve, located downstream of air bleed valve in left wheel well.

(b) Connect this line to test stand pressure hose.

(c) At this same location, disconnect vent line which runs to tee fitting in reservoir filler neck. Cap line.

(d) At filler neck, disconnect both vent lines and connect together with jumper line.

(e) At tee in filler line, disconnect line which runs to high standpipe port at bottom of main reservoir. Cap tee fitting, and connect disconnected line to test stand return hose.

(f) Pressurize test stand to 45 psi maximum at 20 gpm flow.

(g) Flush circuit for five minutes.

(18) Depressurize test stand.

(19) Disconnect test stand pressure hose from overboard line and cap this line. Connect test stand pressure hose to vent line that was capped in Step (17, c).

(20) Repeat Steps (17, f and g).

(21) Depressurize test stand, drain and clean out reservoir. Install new reservoir filter element (see 29-10-2).

(22) Restore all lines and units to original configuration.

F. Auxiliary Hydraulic Pump System Alternate Reservoir (Airplanes 801-811.)

NOTE: The auxiliary pump alternate reservoir may be contaminated by the wing flap return line or the auxiliary pump bypass.

(1) Disconnect wing flap return line from flap return port in main hydraulic reservoir (see Figure 606). Connect line to test stand pressure hose.

(2) Disconnect alternate supply line from supply selector valve (see Figure 604). Connect line to test stand return hose.

(3) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(4) Flush circuit for five minutes.

(5) Depressurize test stand, and drain alternate reservoir.

(6) Restore lines to original configuration.

G. Auxiliary Hydraulic Pump System Alternate Reservoir (Airplanes 812-822.)

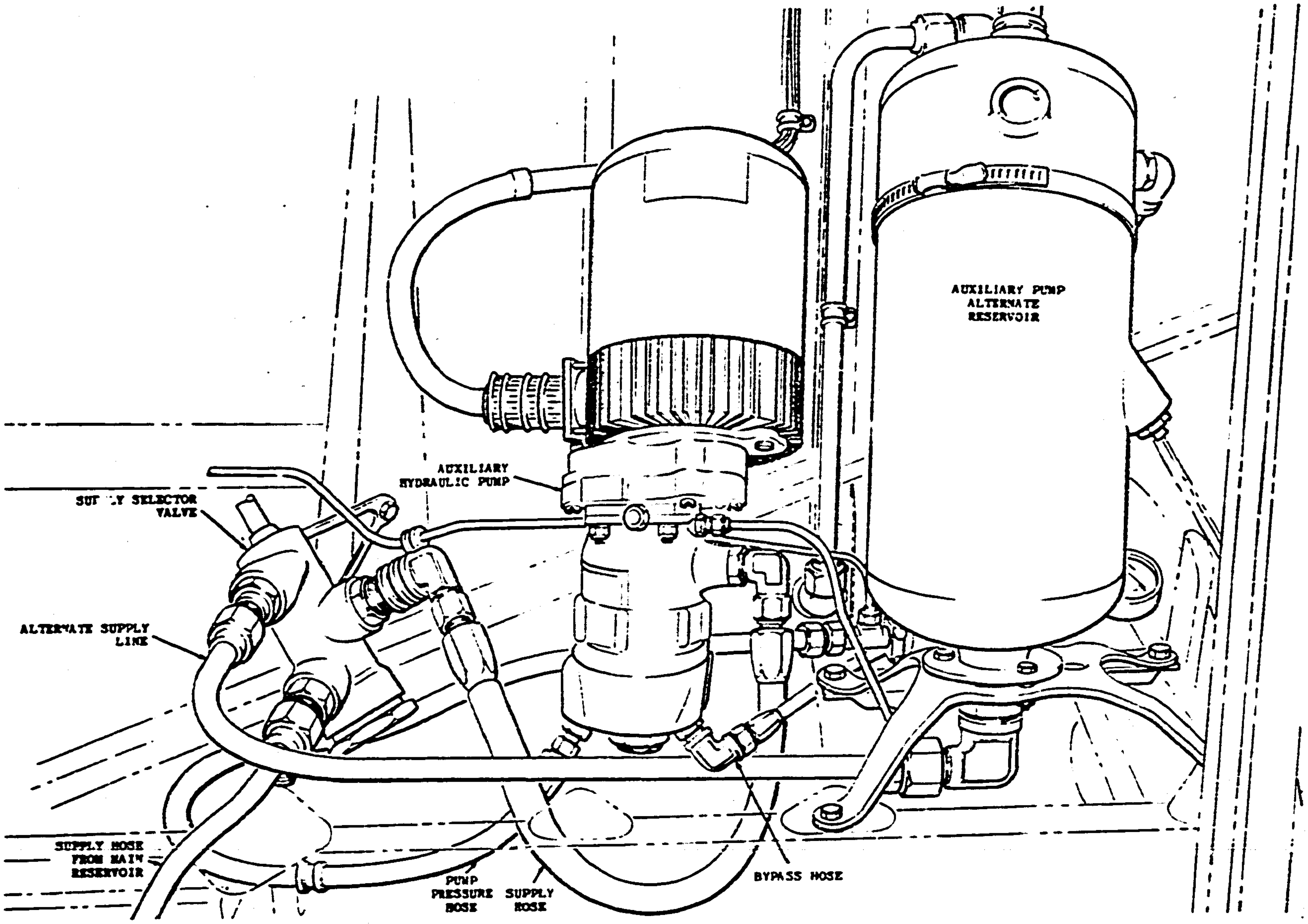
NOTE: The auxiliary pump alternate reservoir may be contaminated by the wing flap return line, the auxiliary pump bypass line, or the low-pressure return lines that tie into the wing flap lines.

(1) Disconnect wing flap return line from tee fitting upstream of low-pressure return line (see Figure 606). Cap tee.

(2) Connect wing flap return line to test stand pressure hose.

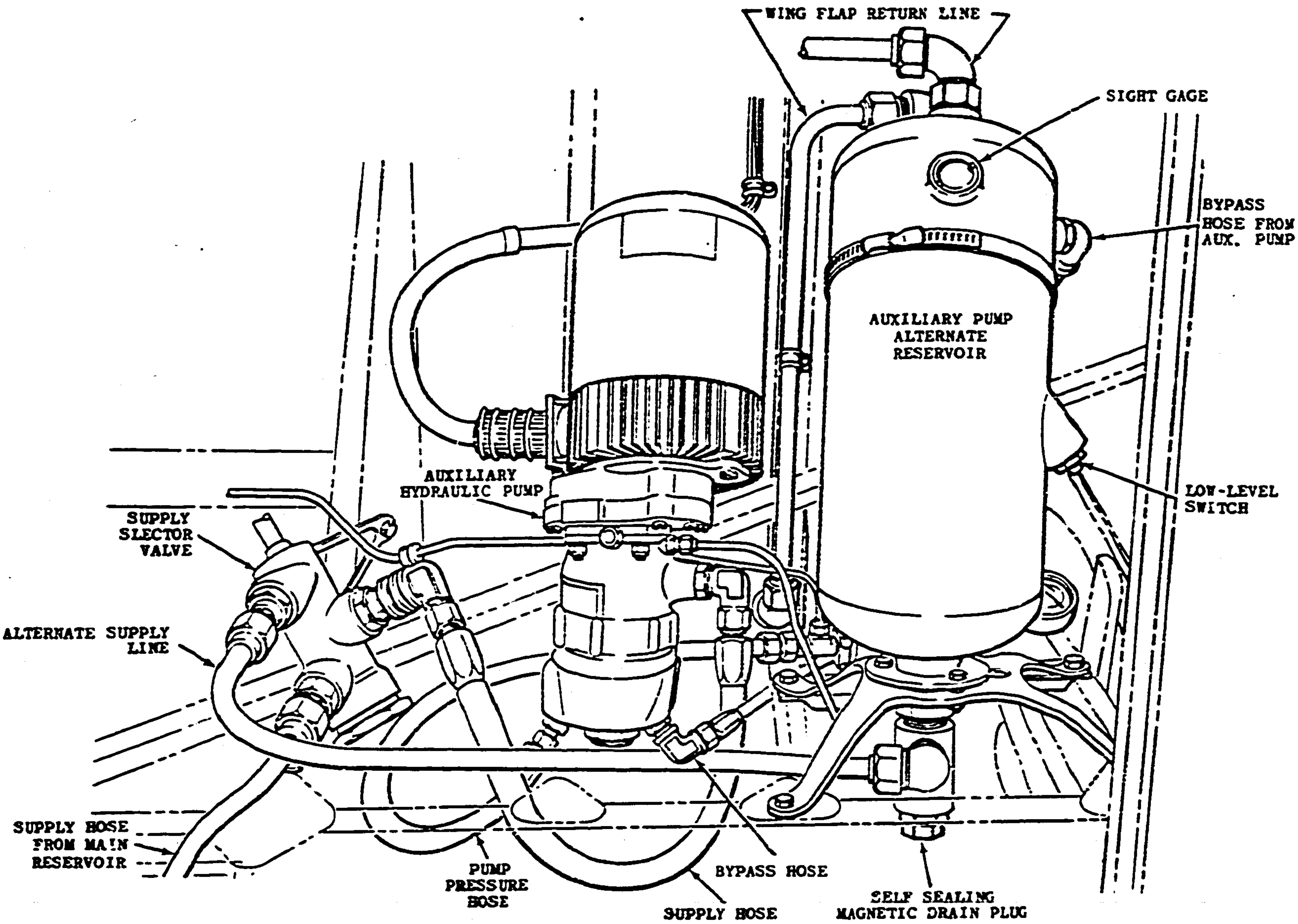
(3) Disconnect alternate supply line from supply selector valve. Connect line to test stand return hose (see Figure 605).

(4) Pressurize test stand to 100 psi maximum at 20 gpm flow.



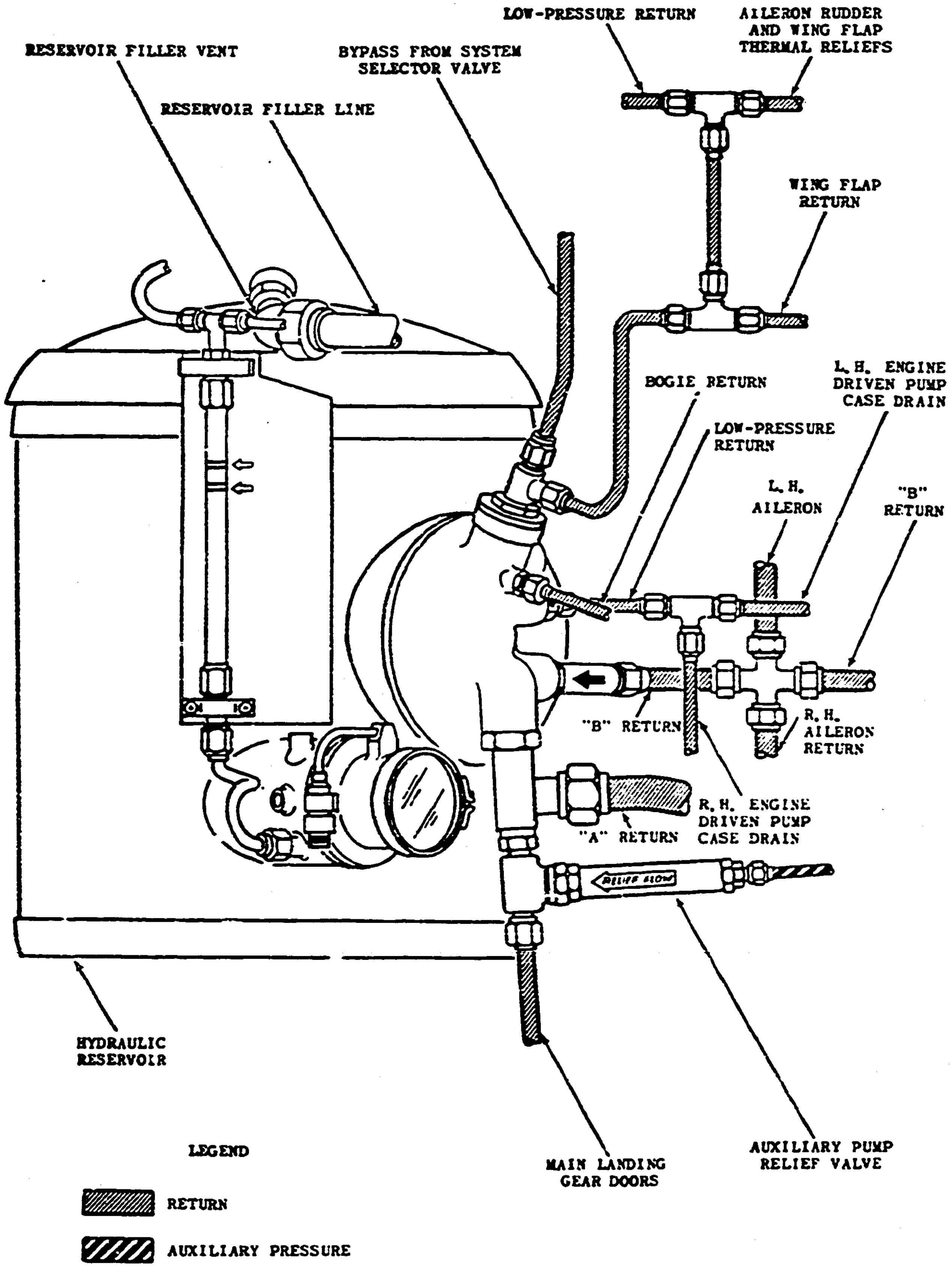
Flushing Procedure Line Connection Locations
(Airplanes 801-811)
Figure 604

H2-5042



Flushing Procedure Line Connection Locations
(Airplanes 812-822)
Figure 605

E2-5375



Flushing Procedure Line Connection Locations
(Airplanes 801-822)
Figure 606

H2-5379

(5) Flush circuit for five minutes.

(6) Depressurize test stand, and drain alternate reservoir (see 29-00, Maintenance Practices).

(7) Restore all lines to original configuration.

H. Auxiliary Hydraulic Pump System (See Figures 604 Through 606.)

(1) Disconnect auxiliary pump supply line from low standpipe port in bottom of main reservoir. Cap reservoir port, and connect line to test stand pressure hose.

(2) Place hydraulic system selector control lever in GENERAL SYSTEM (NORMAL) position.

(3) Disconnect auxiliary pump supply and pressure hoses from pump. Connect these two lines together.

(4) Disconnect auxiliary pump pressure line, and relief valve line from tee fitting located adjacent to auxiliary pump filter. Connect these lines together.

(5) Disconnect auxiliary pump relief valve inlet line from relief valve, located near A-return line of main reservoir. Connect line to test stand return hose.

(6) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Disconnect test stand pressure hose from auxiliary pump supply hose, and connect to supply selector valve alternate supply port.

(10) Place hydraulic system selector control lever in No. 3 position, and repeat Steps (6) through (8).

(11) Remove auxiliary hydraulic pump case drain hose. Clean, and/or replace.

(12) Remove auxiliary pump filter element, clean filter bowl. Install clean filter element (see 29-10-5).

(13) Restore all lines and units to original configuration.

5. Flush Main Hydraulic Power System (Beyond Dual Filter and Relief Valve)

A. Regulator-Aspirator Pressure Line (See Figure 607.)

(1) Remove 1/4-inch regulator-aspirator pressure line, located between aspirator and dual filter and relief valve.

(2) Connect test stand pressure hose to one end of line, and connect test stand return hose to other end.

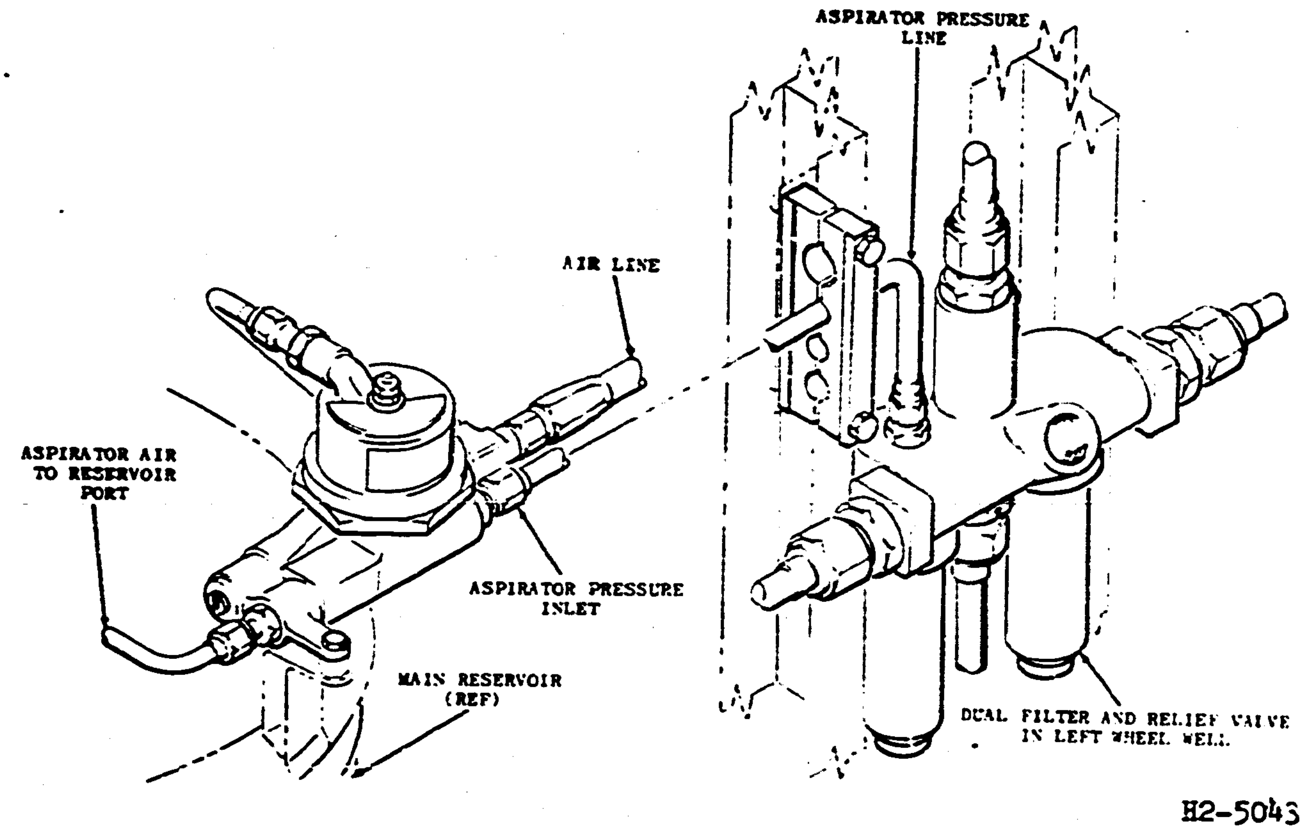
(3) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(4) Flush line for five minutes.

(5) Depressurize test stand and remove hoses.

(6) Inspect regulator-aspirator inlet filter for contamination. Replace or clean filter as necessary.

(7) Connect aspirator line to aspirator and to dual filter and relief valve.



Flushing Procedure Line Connection Locations
Figure 607

B. Empennage Pressure and Return Lines (See Figures 608 Through 610.)

NOTE: This procedure covers the lines from the dual filter and relief valve (outlet side) to the rudder and horizontal stabilizer filter, located in the pressure line in the empennage, and the B-return and low-pressure return lines from the empennage bulkhead back to the left wheel well.

(1) Disconnect pressure line from check valve, located on top side of dual filter and relief valve. Connect this line to test stand pressure hose.

(2) Inspect, clean, and/or replace check valve.

(3) Install jumper line from main system pressure line, at upstream side of system selector control valve, to empennage pressure line located at downstream side of left power manifold (the line with pressure accumulator in it).

(4) Install jumper line around system accumulator.

(5) Disconnect lines which run from tees in low-pressure return line and empennage pressure line to spoiler interconnect valve. Cap tees. Spoiler interconnect valve is located on inboard side of left wheel well.

(6) In empennage, disconnect pressure line at empennage filter. Install jumper between this line and B-return line at pressure bulkhead.

(7) Disconnect empennage B-return line at tee fitting in B-return line, located below left power manifold. Connect aft line to test stand return hose. Cap tee fitting.

(8) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(9) Flush circuit for five minutes.

(10) Depressurize test stand.

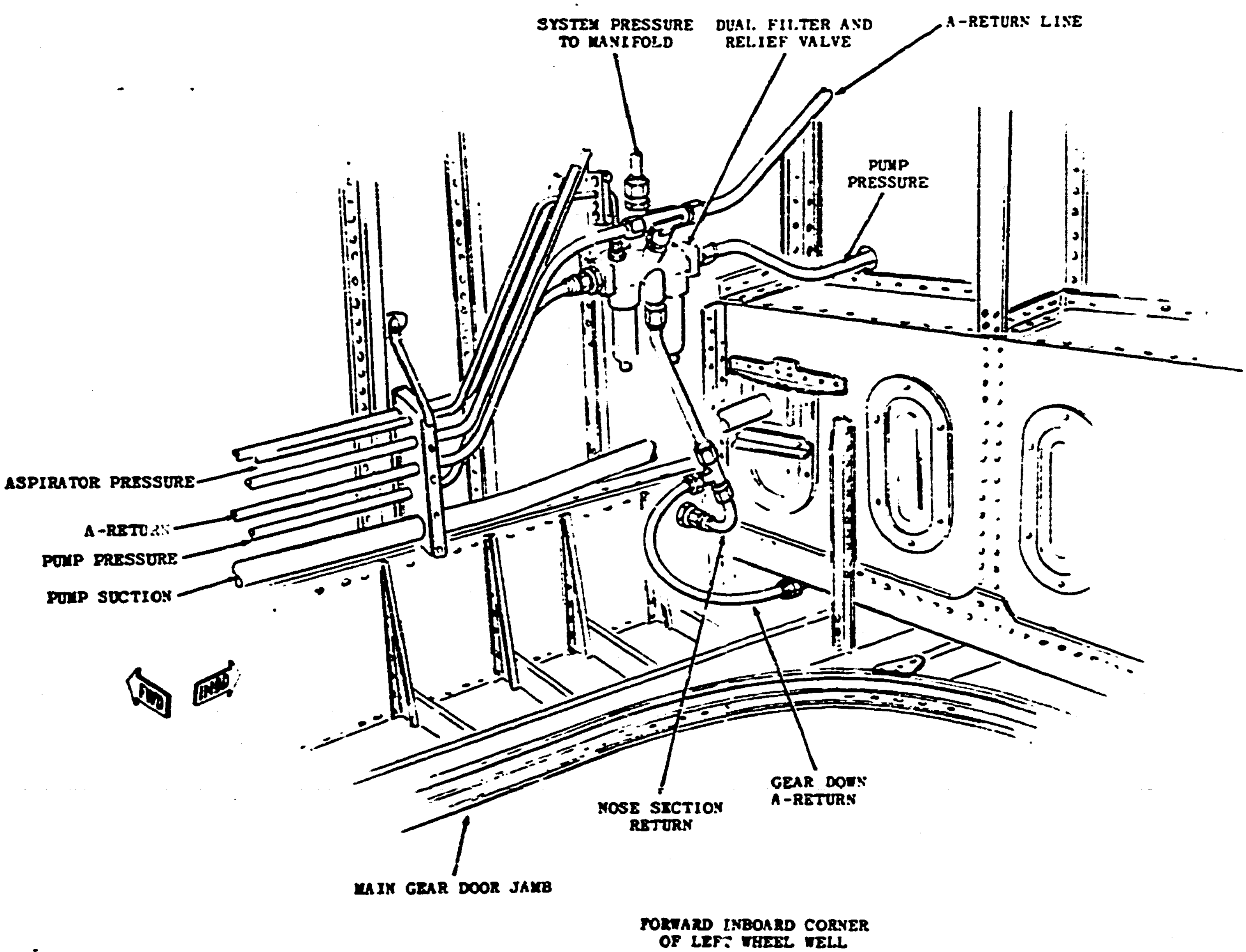
(11) In empennage, disconnect jumper line from B-return line, and connect to low-pressure return line.

(12) Disconnect 1/4-inch low-pressure line (empennage drain) from tee fitting in low-pressure return line (case drain), located to left of centerline of airplane and aft of rear spar.

(13) Disconnect test stand return hose from B-return hose, and connect it to low-pressure return line located inboard of dual filter and relief valve.

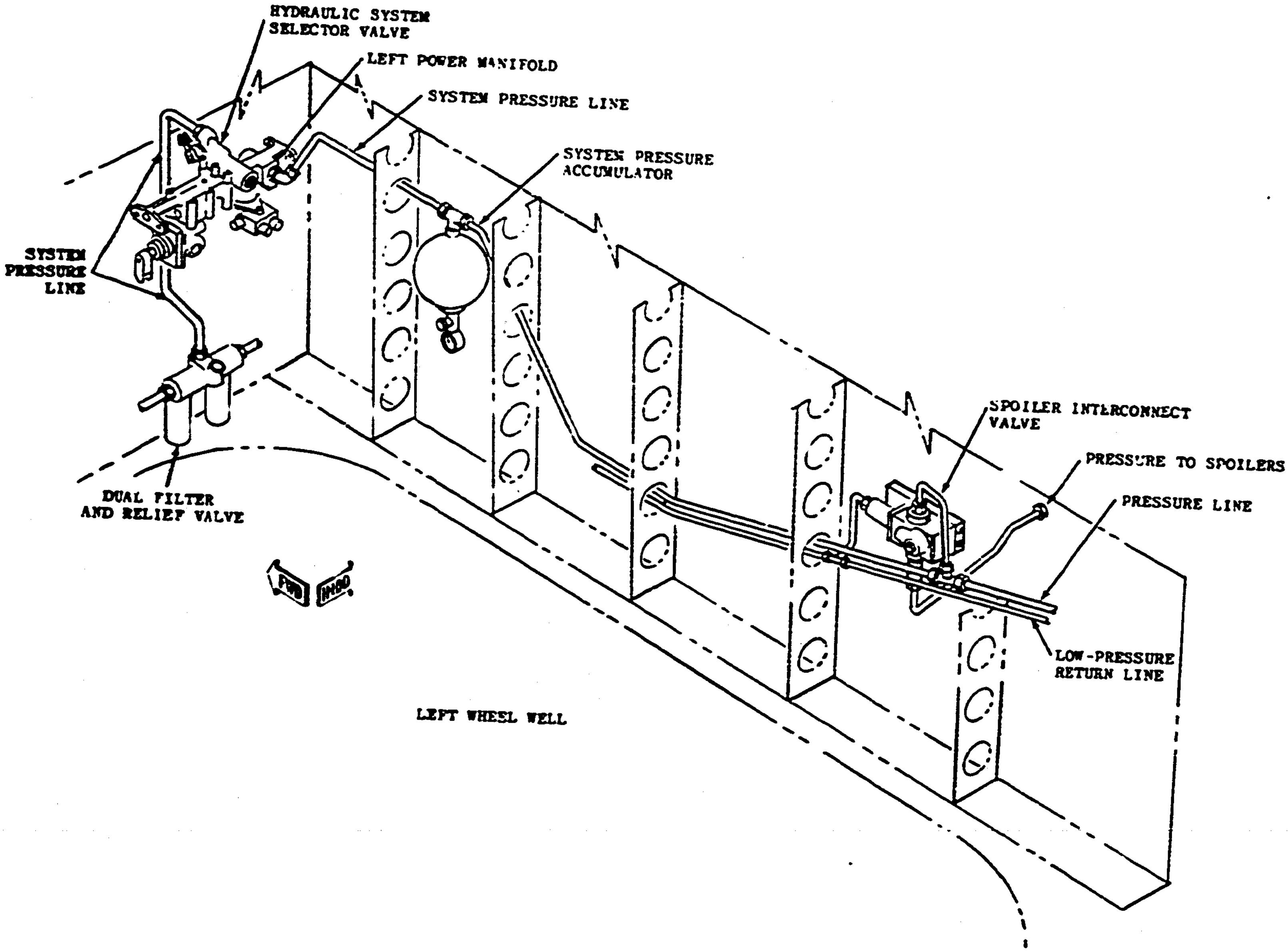
(14) Repeat Steps (8) through (10).

(15) Clean or replace empennage filter element and bowl.



H2-5040

Flushing Procedure Line Connection Locations
Figure 608



H2-5044

Flushing Procedure Line Connection Locations
Figure 609

(16) Inspect, clean, and/or replace hydraulic system accumulator.

(17) Restore all lines and units to original configuration.

(18) For continuation of flushing rudder and horizontal stabilizer systems, refer to Paragraph 8.C.

C. Aileron and Ejector Pressure and Return Lines (Airplanes 801-811, See Figure 611.)

(1) Disconnect pressure line at inboard port of left aileron filter, and disconnect aileron return line from aileron gland. Connect these two lines with jumper.

(2) At return manifold, located at STA X_{rs} = 495, disconnect ejector return and aileron trim tab return and cap both ports.

(3) Disconnect lines which run from thermal relief valve, located at STA X_{rs} = 456, to tees in ejector pressure line and (aileron-ejector) B-return line. Cap tees.

(4) Remove, inspect, clean and/or replace thermal relief valve and attaching lines.

(5) Disconnect pressure and return line which runs from inboard ejector valve to tees in ejector pressure line and (aileron-ejector) B-return line. Cap both tees.

(6) Disconnect left aileron pressure line at aileron shutoff valve, located in left wheel well. Connect line to test stand pressure hose.

(7) Disconnect (aileron-ejector) B-return line from cross fitting near B-return port of main reservoir. Connect line to test stand return hose.

(8) Pressurize test stand to 200 psi at 20 gpm fluid flow.

(9) Flush circuit for five minutes.

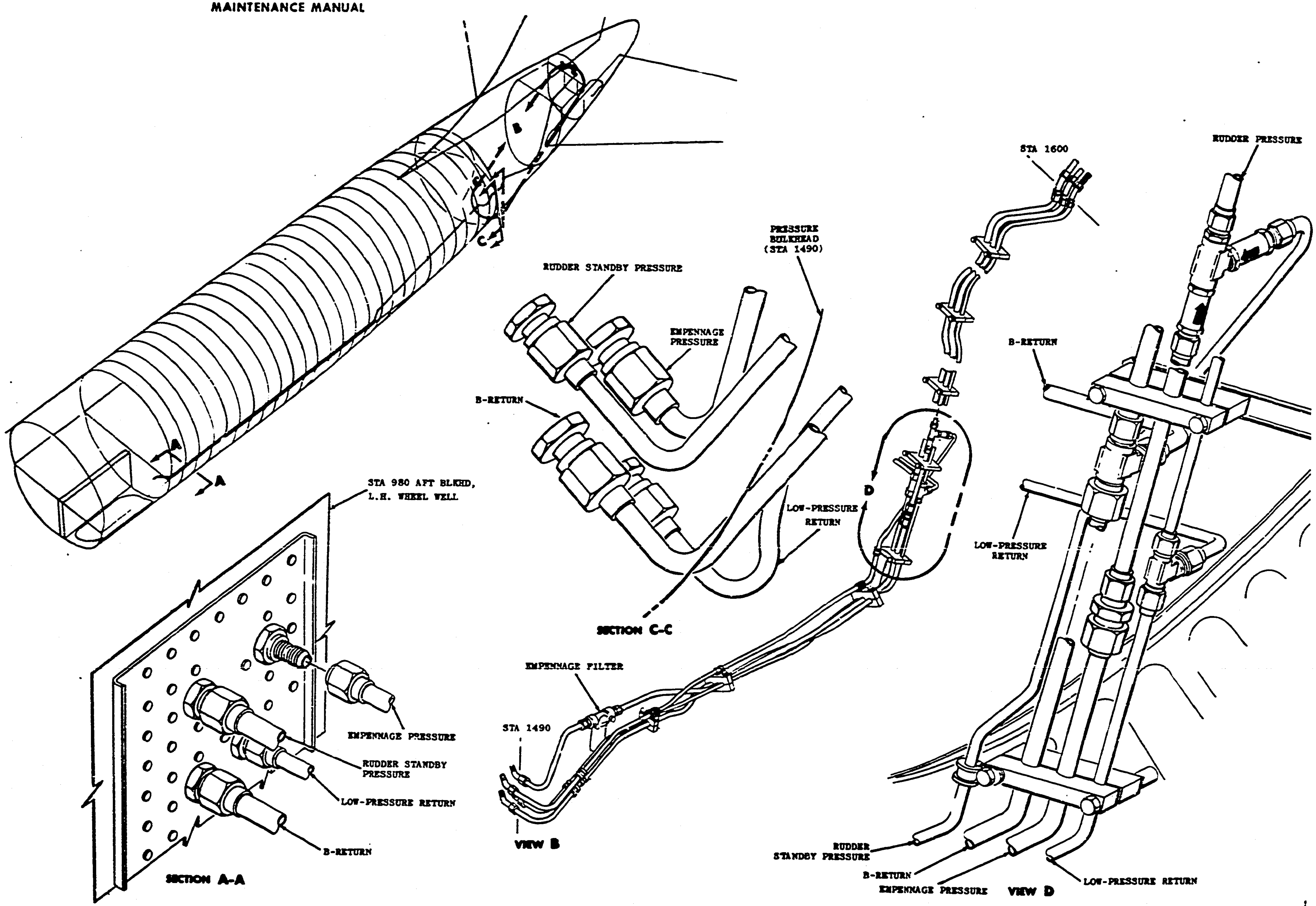
(10) Depressurize test stand.

(11) To flush ejector pressure line, disconnect ejector pressure line from check valve, located just inboard of outboard ejector valve.

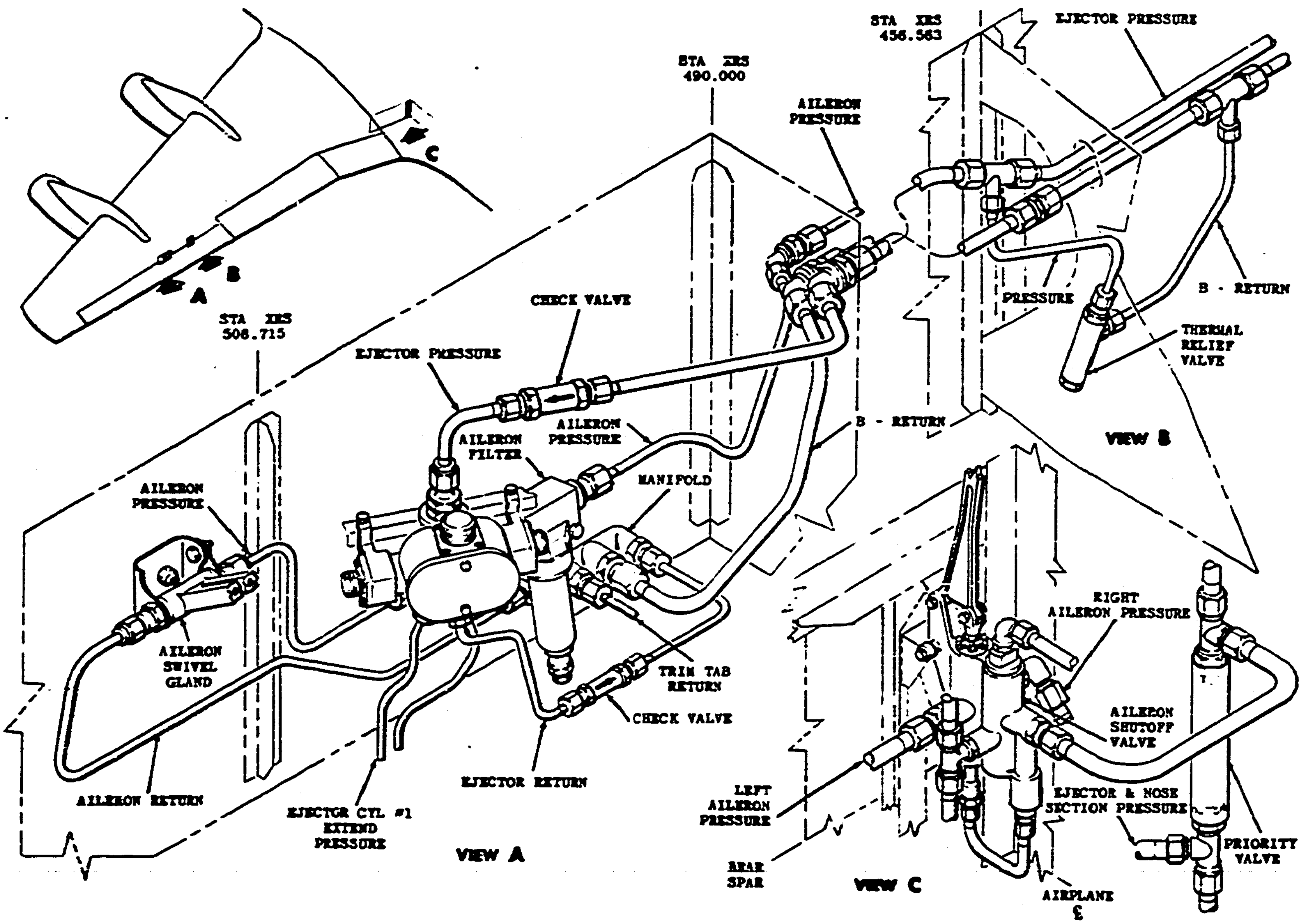
(12) Remove jumper end which was connected to pressure line in Step (1), and connect it to line which was disconnected in Step (11).

(13) In left wheel well disconnect ejector pressure line from tee in nose gear pressure line (second tee below priority valve).

(14) Disconnect test stand pressure hose from aileron shutoff valve pressure line, and connect test stand pressure hose to open ejector pressure line, Step (13).



Flushing Procedure Line Connection Locations
Figure 610



Flushing Procedure Line Connection Locations
(Airplanes 801-811)
Figure 611

(15) Below this connection, disconnect ejector pressure line from tee which supplies right ejectors. Cap tee.

(16) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(17) Flush circuit for five minutes.

(18) Depressurize test stand.

(19) Remove, inspect, clean, and/or replace check valves (two at each ejector valve), and short connecting lines to ejector valves.

(20) Repeat Steps (1) through (19) for right side of airplane with these exceptions:

(a) Right side of airplane uses (aileron-ejector) A-return line. Disconnect test stand return hose from B-return cross at reservoir, and connect test stand return hose to A-return line at tee in bottom of right power manifold in right wheel well.

(21) Remove, inspect, clean, and/or replace ejector thermal relief valves with attaching lines, located at STA X_{rs} = 456.

(22) Remove, clean, and/or replace priority valve and fittings, located on bottom of left power manifold.

(23) Restore all lines and units to original configuration.

(24) For continuation of flushing aileron and ejector systems, refer to Paragraphs 7.G. and 8.A.

D. Aileron Pressure and Return Lines (Airplanes 812-822, See Figure 612.)

(1) Disconnect aileron pressure line at inboard port of left aileron filter, and disconnect aileron B-return line from aileron swivel gland. Connect these two lines together with jumper.

(2) At return manifold, located at STA X_{rs} = 495, disconnect aileron trim tab B-return line. Cap manifold port.

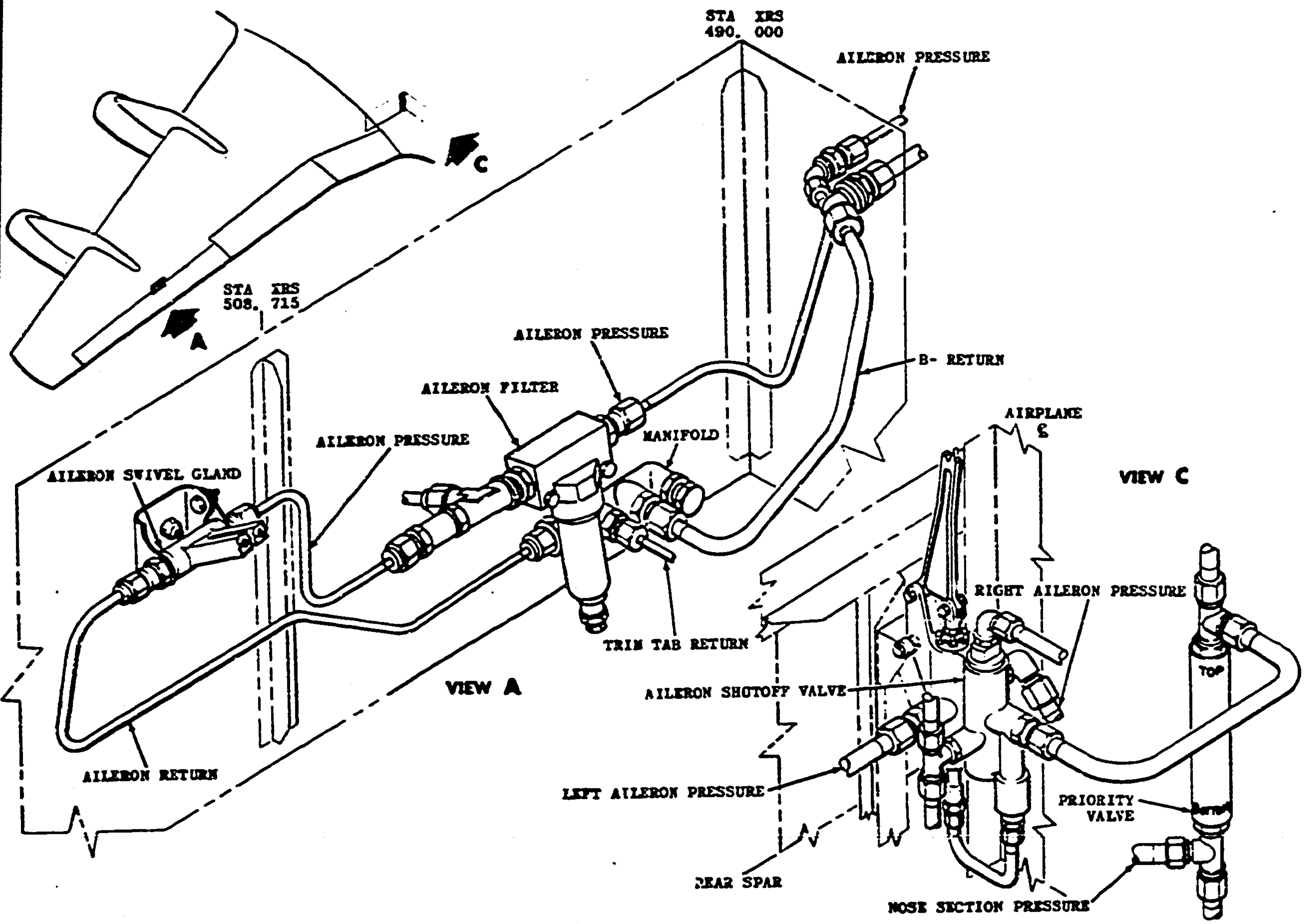
(3) Disconnect left aileron pressure line at aileron shutoff valve, located in left wheel well. Connect this line to test stand pressure hose.

(4) Disconnect aileron B-return line from cross fitting at B-return port of reservoir. Connect this line to test stand return hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for five minutes.

(7) Depressurize test stand.



Flushing Procedure Line Connection Locations
(Airplanes 812-822)
Figure 612

H2-5089

(8) Disconnect pressure line at inboard port of right aileron filter, and disconnect aileron A-return line from aileron swivel gland. Connect these two lines together.

(9) At return manifold, located at STA X_{rs} = 495, disconnect aileron trim tab A-return line. Cap manifold port.

(10) Disconnect right aileron pressure line at aileron shutoff valve, located in left wheel well. Connect line to test stand pressure hose.

(11) Disconnect aileron A-return line from tee at the bottom of right power manifold, located in right wheel well. Connect line to test stand return hose.

(12) Repeat Steps (5) through (7) for these lines.

(13) Remove, inspect, clean, and/or replace priority valve and fittings, located on bottom of the left power manifold.

(14) Restore all lines and units to original configuration.

(15) For continuation of flushing aileron system components, refer to Paragraph 8.A.

E. Nose System Pressure and Return Lines (Airplanes 801-811, See Figure 613.)

(1) In nosewheel well, disconnect 1/4-inch return line which runs from nose gear control valve to bulkhead tee fitting in A-return line, at the tee. Cap tee.

(2) Disconnect pressure line leading into nose gear control valve at valve. In this same line, replace check valve with jumper line.

(3) Disconnect pressure line which runs to tee in pressure accumulator, from pressure bulkhead tee at rear of wheel well.

(4) Connect two open lines from Step (2) and Step (3) with jumper.

(5) Disconnect at tee, pressure line which runs from reserve pressure accumulators to tee near centerline of airplane. Cap tee.

(6) Disconnect pressure line leading into reserve accumulator shutoff valve.

(7) Disconnect return line from tee in steering relief valve. Connect this line to pressure line at shutoff valve with jumper line.

(8) In left main gear wheel well disconnect nose system pressure line from side port of tee in the bottom of priority valve. Connect line to test stand pressure hose.

(9) Disconnect nose system A-return line from bottom of dual filter and relief valve. Connect line to test stand return hose.

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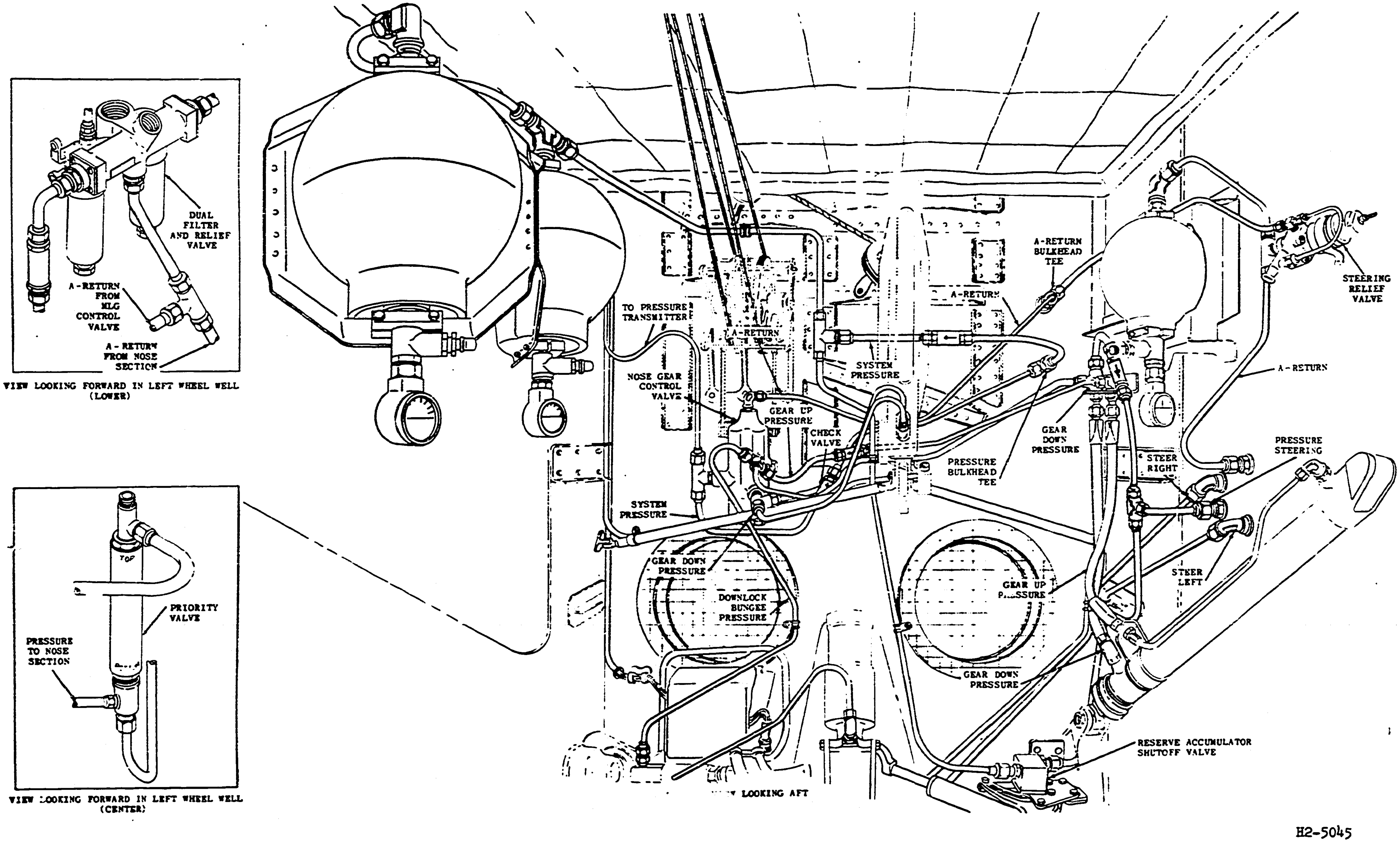

Flushing Procedure Line Connection Locations
(Airplanes 801-811)
Figure 613

(10) Disconnect main gear control valve A-return line from tee in nose gear A-return line. Cap tee.

(11) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(12) Flush circuit for five minutes.

(13) Depressurize test stand.

(14) Remove, inspect, clean, and/or replace miniature check valve, located in nose system return port of dual filter and relief valve.

(15) Repeat Step (14), inspection etc., for following items:

(a) Two check valves jumpered in nosewheel well

(b) Two reserve pressure accumulators and attaching lines

(c) System pressure transmitter and attaching lines.

(16) Restore all lines and units to original configuration.

(17) For continuation of flushing of nose gear system, refer to Paragraph 7.F.

F. Nose System Pressure and Return Lines (Airplanes 812-822, See Figure 614.)

(1) In nosewheel well, disconnect 1/4-inch return line which runs from nose gear control valve to bulkhead tee fitting in A-return line, at tee. Cap tee.

(2) Disconnect pressure line leading into nose gear control valve at valve. In this same line, replace check valve with jumper line.

(3) Disconnect pressure line which runs to tee in pressure accumulator, from pressure bulkhead tee at rear of wheel well.

(4) Connect two open lines from Step (2) and Step (3) with jumper.

(5) Disconnect at tee, pressure line which runs from reserve pressure accumulators to tee near centerline of airplane. Cap tee.

(6) Disconnect pressure line leading into reserve accumulator shutoff valve.

(7) Disconnect return line from tee in steering relief valve. Connect this line to pressure line at shutoff valve with jumper line.

(8) Disconnect cargo door pressure line at tee fitting in nose system pressure line. Cap tee and cargo door pressure line.

<u>NOTE</u>: The cargo door pressure line tee fitting is located in the forward left side of the forward baggage compartment.

(9) In left main gear wheel, well disconnect nose system pressure line from side port of tee in priority valve. Connect line to test stand pressure hose.

(10) Disconnect nose system A-return line from bottom of dual filter and relief valve. Connect line to test stand return hose.

(11) Disconnect main gear control valve A-return line from tee in nose gear A-return line. Cap tee.

(12) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(13) Flush circuit for five minutes.

(14) Depressurize test stand.

(15) Remove, inspect, clean, and/or replace miniature check valve, located in nose system return port of dual filter and relief valve.

(16) Repeat Step (15), inspection etc., for following items:

(a) Two check valves jumpered in nosewheel well

(b) Two reserve pressure accumulators and attaching lines

(c) System pressure transmitter and attaching lines.

(17) Restore all lines and units to original configuration.

(18) For continuation of flushing of nose gear system, refer to Paragraph 7.F.

G. Flush the A-Return Line (See Figure 615.)

(1) Disconnect aileron A-return line from tee in A-return line, located below left power manifold. Cap tee.

(2) Disconnect at manifold, short line that runs from tee (see Step 16) to left power manifold. Connect line to test stand pressure hose.

(3) Place jumper around miniature check valve, located in A-return line under left power manifold.

(4) Disconnect A-return lines from tee in dual filter and relief valve. Install jumper between these lines.

(5) Disconnect A-return line from reservoir fittings. Connect line to test stand return hose.

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

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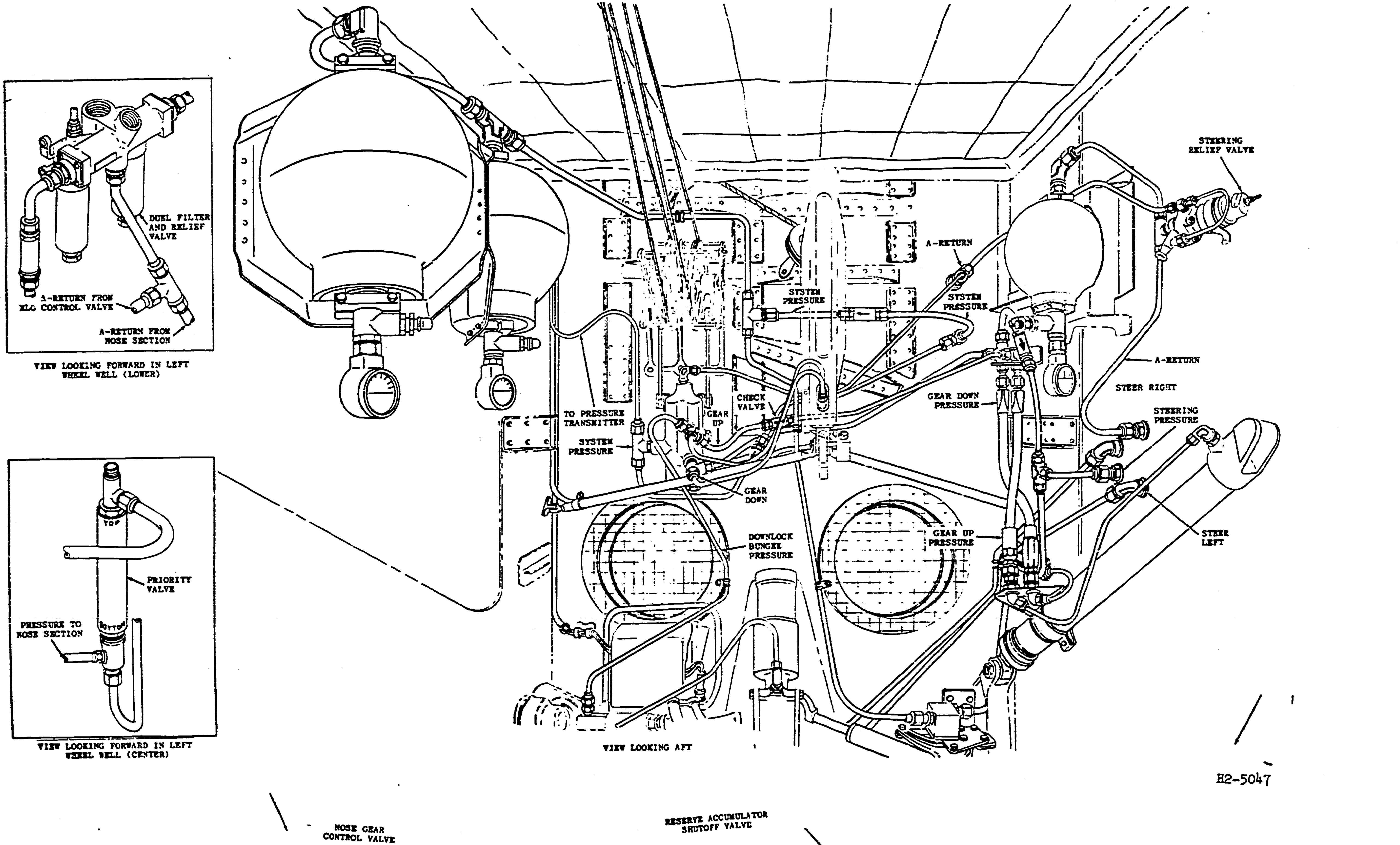
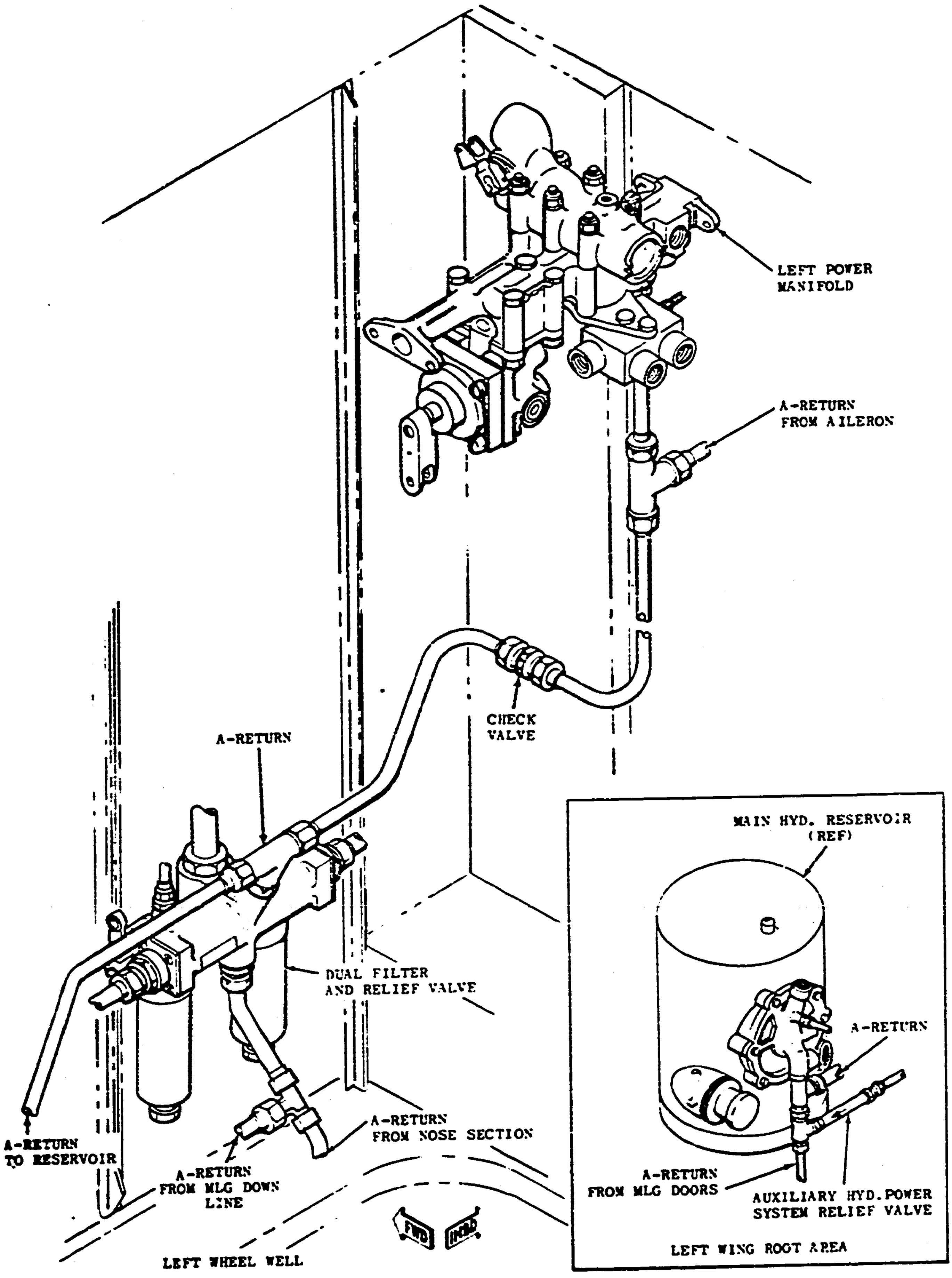


Flushing Procedure Line Connection Locations
(Airplanes 812-822)
Figure 614



H2-5048

Flushing Procedure Line Connection Locations
Figure 615

(8) Depressurize test stand.

(9) Inspect, clean, and/or replace miniature check valve which was removed in Step (3).

(10) Restore all lines and units to original configuration.

H. Flush the B-Return Line (See Figure 616.)

(1) Disconnect B-return line from miniature check valve installed in right power manifold. Connect this line to test stand pressure hose.

(2) Disconnect empennage return line from tee in B-return line. Cap tee.

(3) Disconnect left antiskid return line, and left aileron return line from B-return cross fitting located adjacent to main reservoir. Cap two openings.

(4) Disconnect B-return line from check valve in reservoir B port. Connect line to test stand return hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Remove check valve from reservoir B port, and miniature check valve (Step 1.). Inspect, clean, and/or replace check valves.

(9) Restore all lines and units to original configuration.

I. Power Manifolds

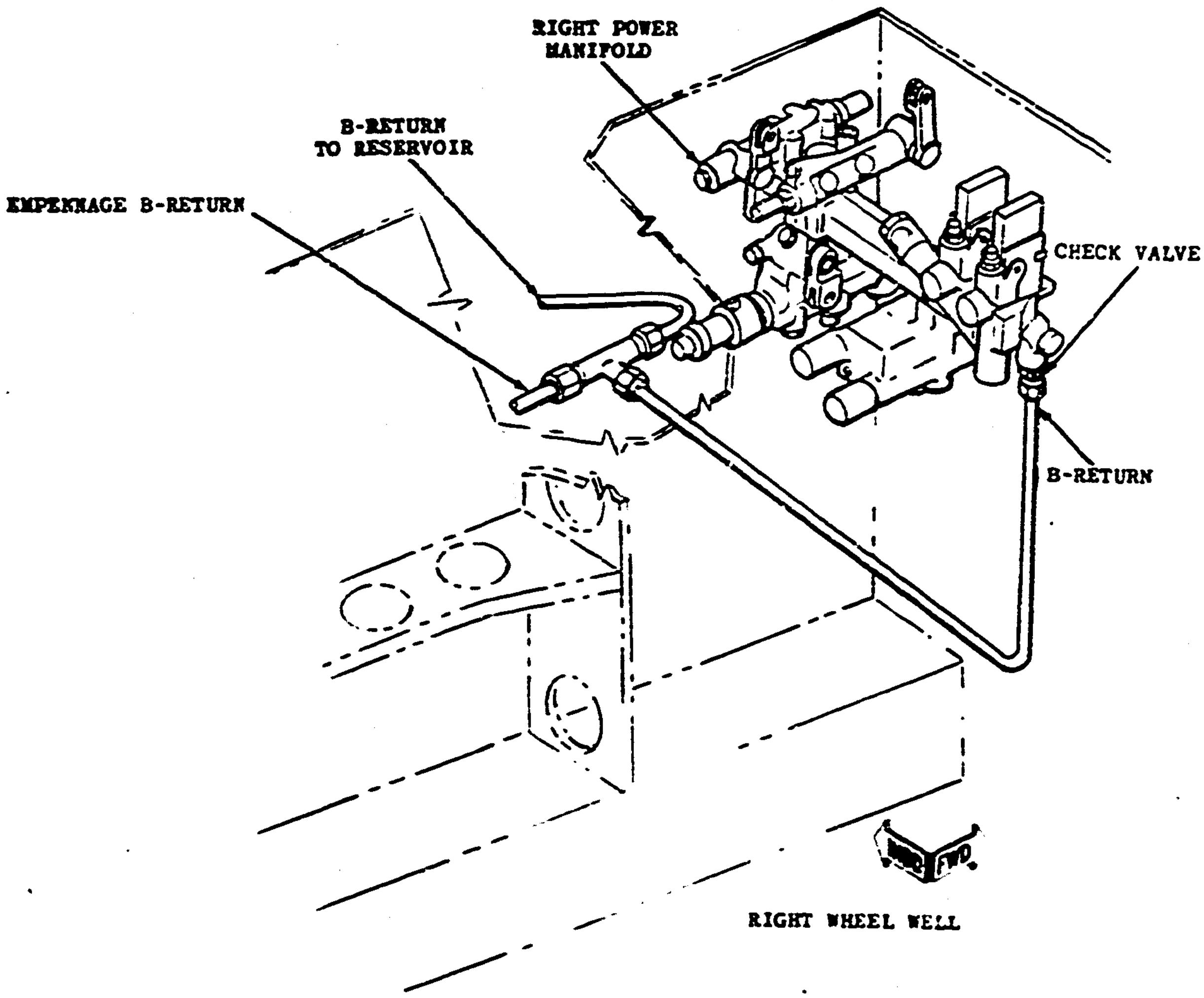
(1) If contamination downstream of the dual filter and relief valve is general, the right and left power manifolds with attaching valves must be removed, inspected, cleaned, and/or replaced.

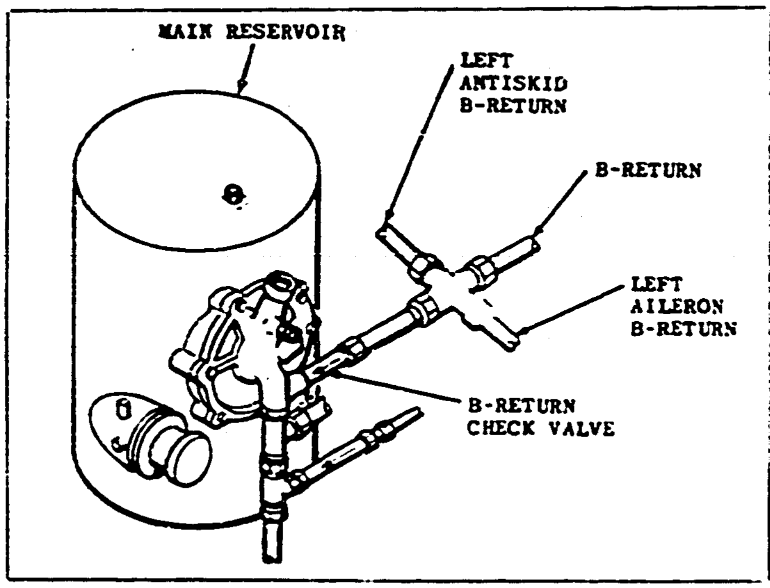
J. Flush Low-Pressure Return Lines (Airplanes 801-811, See Figure 617.)

(1) In right wing root area, disconnect low-pressure return line from wing flap thermal relief valve, located on wing spar. Connect this line to test stand pressure hose. Cap thermal relief valve.

(2) Disconnect No. 3 engine pump case drain line from tee fitting, located below thermal relief valve. Cap tee and case drain line.

(3) At cross-ship tee in low-pressure return line, located in forward inboard corner of left wheel well, disconnect low-pressure return line from aileron and empennage. Cap tee and aileron and empennage return line.

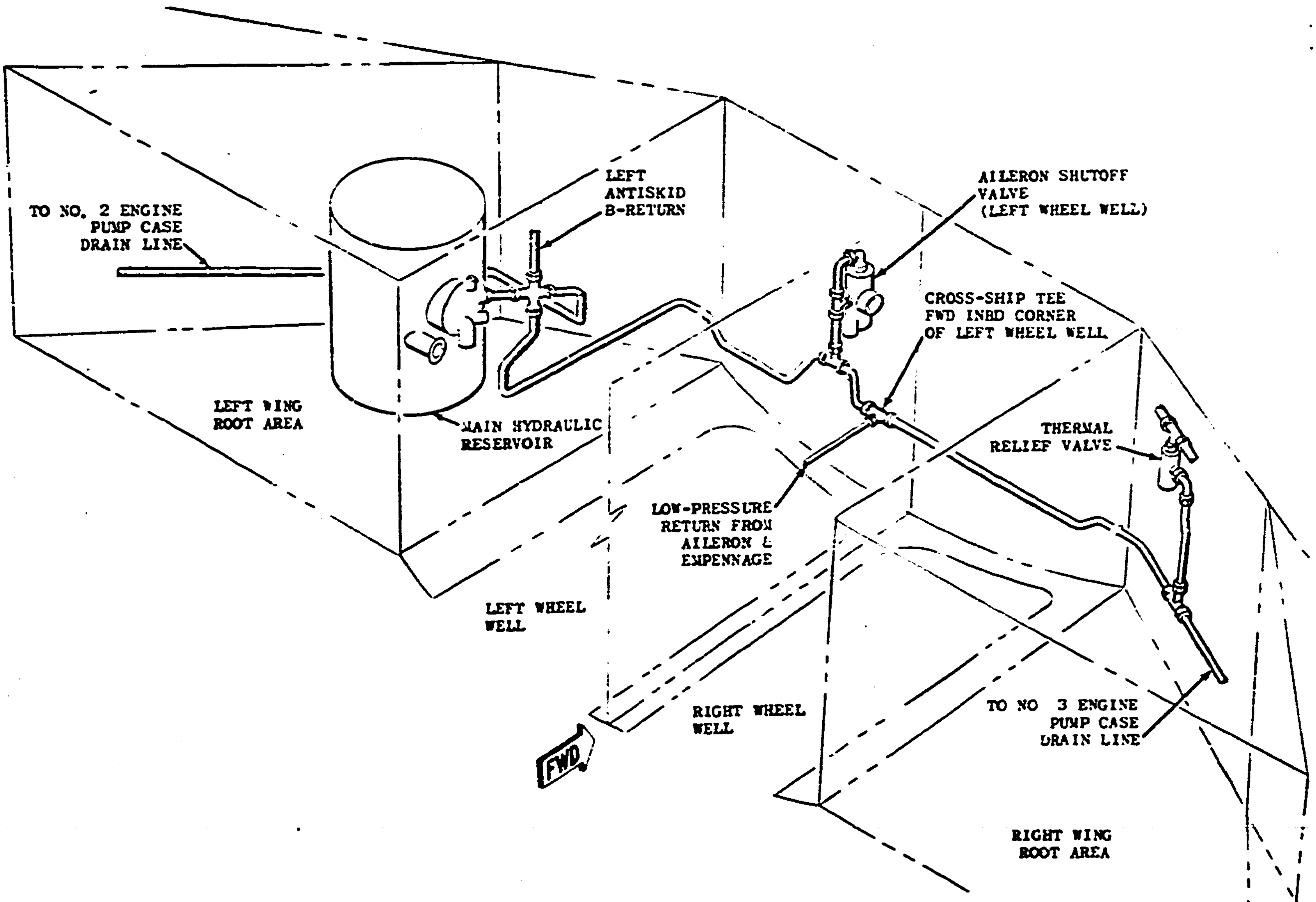




LEFT WING ROOT AREA

H2-5049

Flushing Procedure Line Connection Locations
Figure 616



Flushing Procedure Line Connection Locations
(Airplanes 801-811)
Figure 617

H2-5497

(4) Disconnect aileron shutoff valve low-pressure return line from tee fitting, located below aileron shutoff valve (in left wheel well). Cap tee fitting.

(5) Disconnect low-pressure return line from bottom of tee fitting at reservoir low-pressure return port. Connect test stand return hose to line. Cap tee.

(6) Pressurize test stand to 200 psi at 20 gpm maximum flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Disconnect short line from top of aileron shutoff valve to tee mentioned in Step (4). Bench flush this line.

(10) Remove and clean aileron shutoff valve, and thermal relief valve.

(11) Restore all lines and units to original configuration.

K. Flush Low-Pressure Return Lines (Airplanes 812-822, See Figure 618.)

(1) In right wing root area, disconnect low-pressure return line from wing flap thermal relief valve. Connect this line to test stand pressure hose. Thermal relief valve is located on the rear spar.

(2) In left wheel well, disconnect low-pressure return line from tee which connects aileron and empennage returns to cross-ship low-pressure return. Cap tee.

(3) Disconnect low-pressure return line from tee fitting that joins wing flap return at main reservoir. Cap tee, and connect line to test stand return hose.

(4) Pressurize test stand to 200 psi at 20 gpm flow.

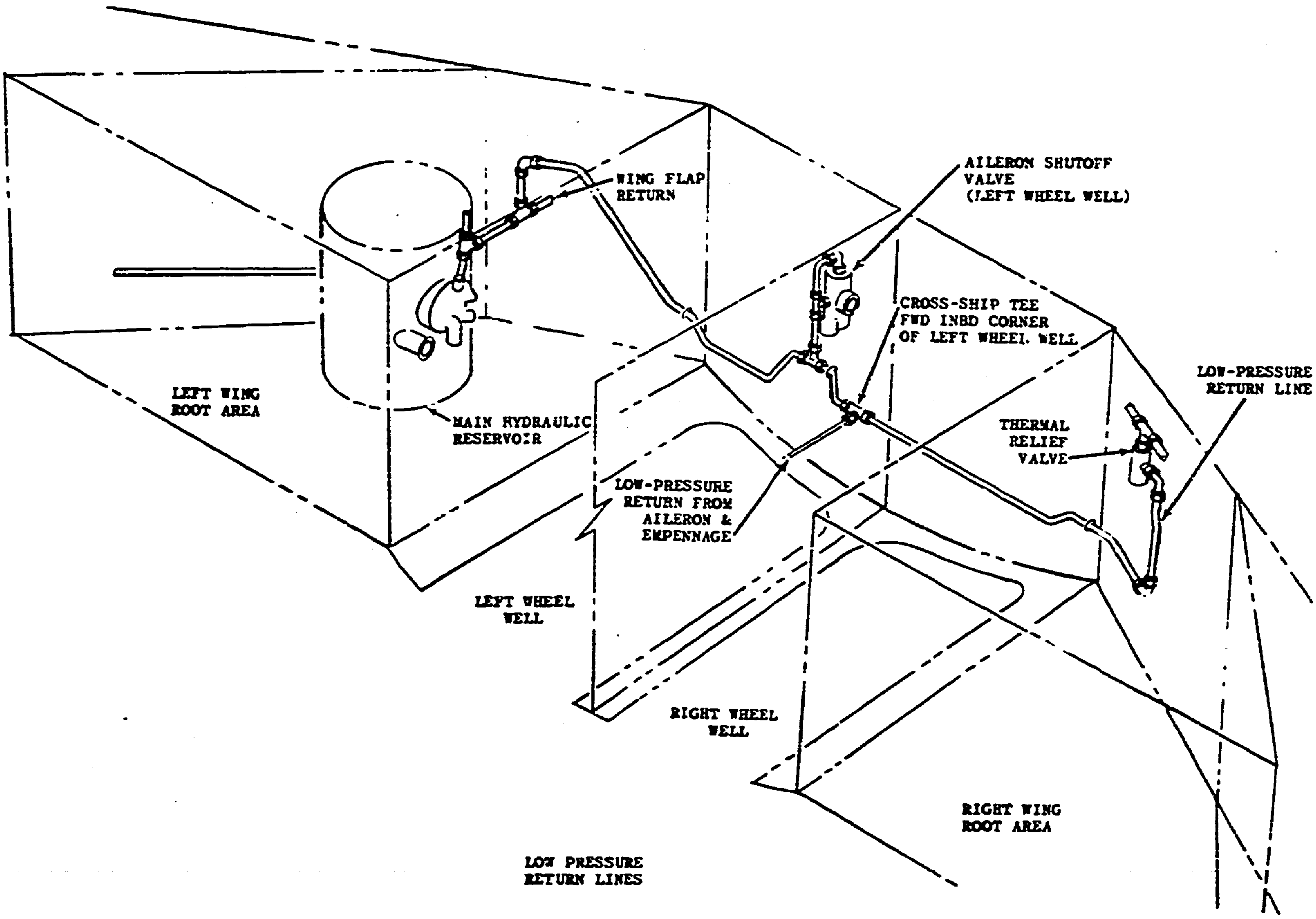
(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Remove line from aileron shutoff valve to tee fitting in low-pressure return line, in left wheel well. Flush line.

(8) Remove, clean and/or replace aileron shutoff valve and thermal relief valve.

(9) Restore all lines and units to original configuration.



Flushing Procedure Line Connection Locations
(Airplanes 812-822)
Figure 618

H2-5376

6. Flush Auxiliary Hydraulic Power System

A. Auxiliary Pressure Lines to Wing Flap System (See Figure 619.)

(1) Disconnect pressure line from downstream side (forward) of auxiliary hydraulic pump filter. Connect this line to test stand pressure hose.

(2) Clean auxiliary pump filter (see 29-1-5).

(3) Remove check valve located above the filter from auxiliary pressure line, and install jumper line in its place.

(4) Disconnect auxiliary pressure lines from inlet and outlet ports of system selector control valve, and install jumper between these lines. Cap valve ports.

(5) Disconnect auxiliary pressure line from wing flap inlet port in right power manifold. Connect line to test stand return hose.

(6) Pressurize test stand to 200 psi maximum at 3 to 10 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Remove jumper lines, clean, and/or replace check valve removed in Step (3).

(10) Connect all lines except right and left main gear bungee cylinder lines.

7. Flush Utility Systems Upstream of Control System Filters

A. Wing Flap System

(1) Disconnect flap up and flap down lines from wing flap control valve.

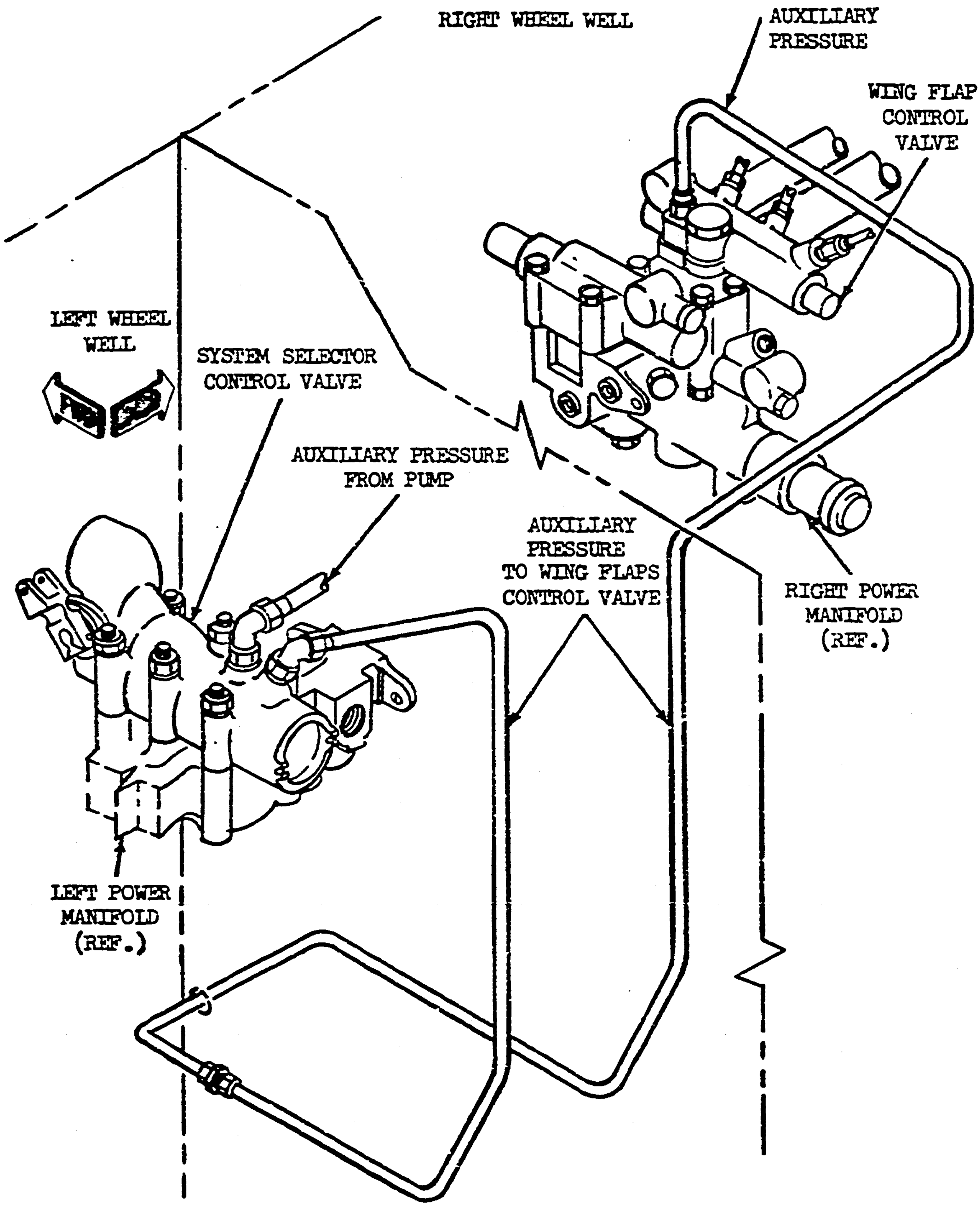
(2) Remove restrictor with portion of wing flap up line, which is connected to wing flap control valve.

(3) Disconnect flap return line from right power manifold, and jumper this line to flap down line, which was disconnected in Step (1).

(4) Connect open flap up line to test stand pressure hose.

(5) Disconnect flap return line from inlet port of auxiliary pump alternate reservoir. Connect this line to test stand return hose.

(6) Remove thermal relief valve from tee in flap up line, located at STA X_{rs} = 70 in right wing root. Cap tee.



Flushing Procedure Line Connection Locations
Figure 619

(7) Disconnect hoses from six flap cylinders. Cap all hoses except outboard left flap cylinder hoses. Connect jumper across these two hoses.

(8) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(9) Flush circuit for three minutes.

(10) Depressurize test stand.

(11) Move jumper to mid-wing hoses, cap outboard hoses, and repeat Steps (8) through (10).

(12) Move jumper to inboard hoses, cap mid-wing hoses, and repeat Steps (8) through (10).

(13) Repeat Steps (7) through (10) for lines on right side of airplane making sure that hoses on left side are capped.

(14) Flush short line that runs between thermal relief valve and tee in low-pressure return line.

(15) Inspect, clean, and/or replace all flap cylinders, thermal relief valve, restrictor valve, and flap control valve.

(16) Restore all lines and units to original configuration.

(17) Adjust rigging if necessary (see Chapter 27).

B. Wing Slot System

(1) Disconnect slots open and slots closed lines from wing slot control valve, located on right power manifold.

(2) Connect slots open line to test stand pressure hose. Connect slots closed line to test stand return hose.

(3) Disconnect lines from 4 slot cylinders, cap all lines except outboard right cylinder lines. Install jumper across these two lines.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for three minutes.

(6) Depressurize test stand.

(7) Move jumper to right inboard slot cylinder lines, cap outboard lines, and repeat Steps (4) through (6).

(8) Repeat Steps (3) through (7) for left side. Make certain that all lines on both sides of airplane, with exception of jumpered lines, are capped.

(9) Inspect, clean, and/or replace wing slot cylinders and wing slot control valve, located on right power manifold.

(10) Restore all lines and units to original configuration. Adjust rigging if necessary per Chapter 27.

C. Main Gear Retract System (See Figures 620 and 621.)

(1) Disconnect gear up pressure line, gear down pressure line, and gear down return lines from main gear control valve.

(2) Connect jumper between gear down pressure line and gear down A-return line.

(3) Connect gear up line to test stand pressure hose.

(4) Disconnect gear down A-return line from tee in (nose gear return) A-return line, located in left wheel well aft of rear spar and below dual filter and relief valve. Connect line to test stand return hose.

(5) Disconnect right gear up and gear down lines from tees, located to right of centerline of airplane. Cap tees. Left gear retract system will be flushed first.

(6) In left wheel well, disconnect both main gear uplatch lines from tees in gear up and gear down lines. Cap tees.

(7) Disconnect both main gear door latch lines from tees in gear up and gear down lines near wing root. Cap tees.

(8) Disconnect downlock bungee pressure line from tee in gear up line. Cap tee.

(9) Disconnect line, which leads to bungee cylinder, from tee in gear down line. Cap tee.

(10) Disconnect line, which leads to gear door manual open valve, from tee in main gear down line. Cap tee.

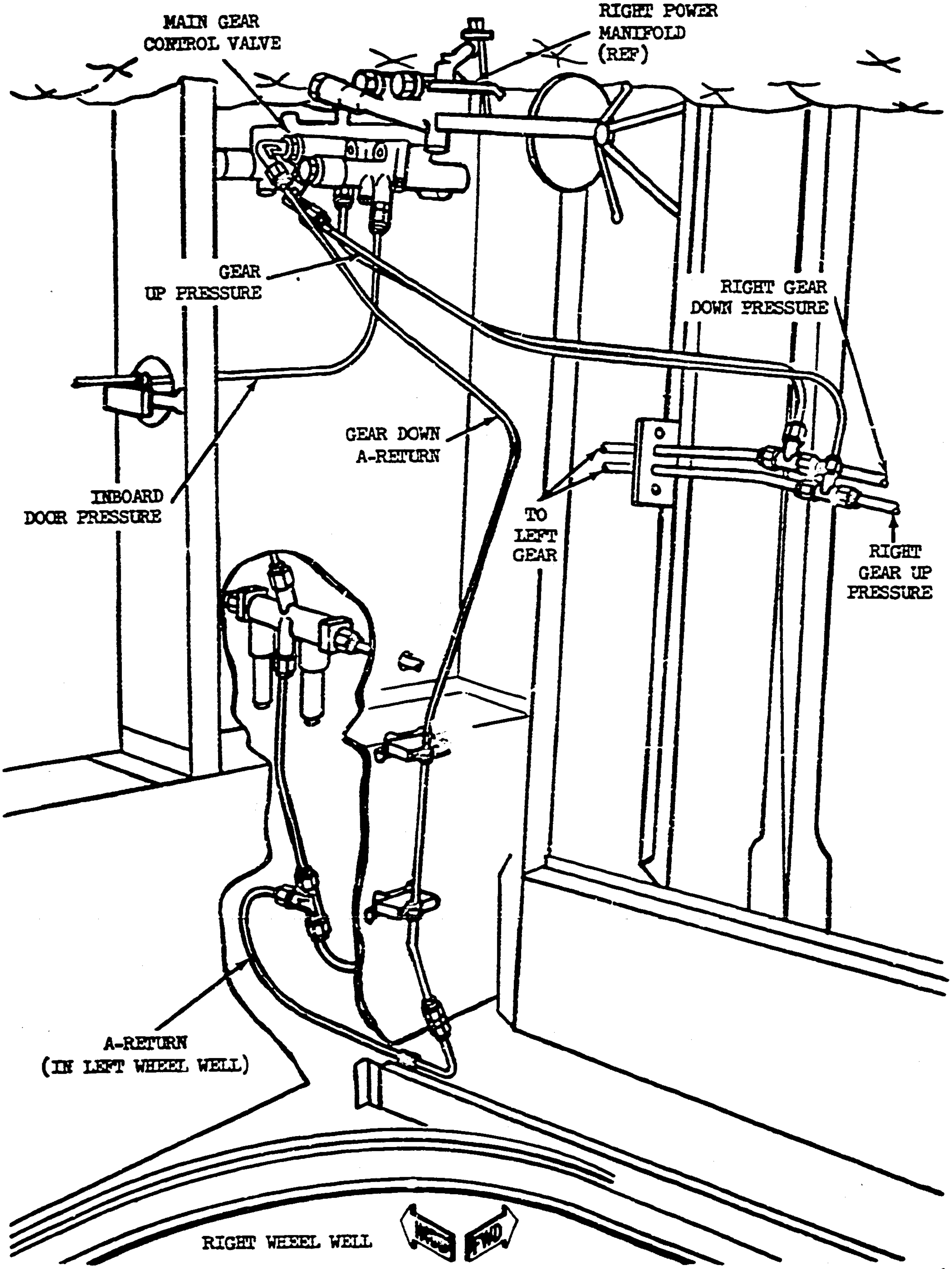
(11) Replace restrictor in gear down line with jumper.

(12) Disconnect gear up and gear down lines from upstream side of actuating cylinder swivel gland. Connect jumper between these lines.

(13) Pressurize test stand to 200 psi maximum at 20 gpm flow.

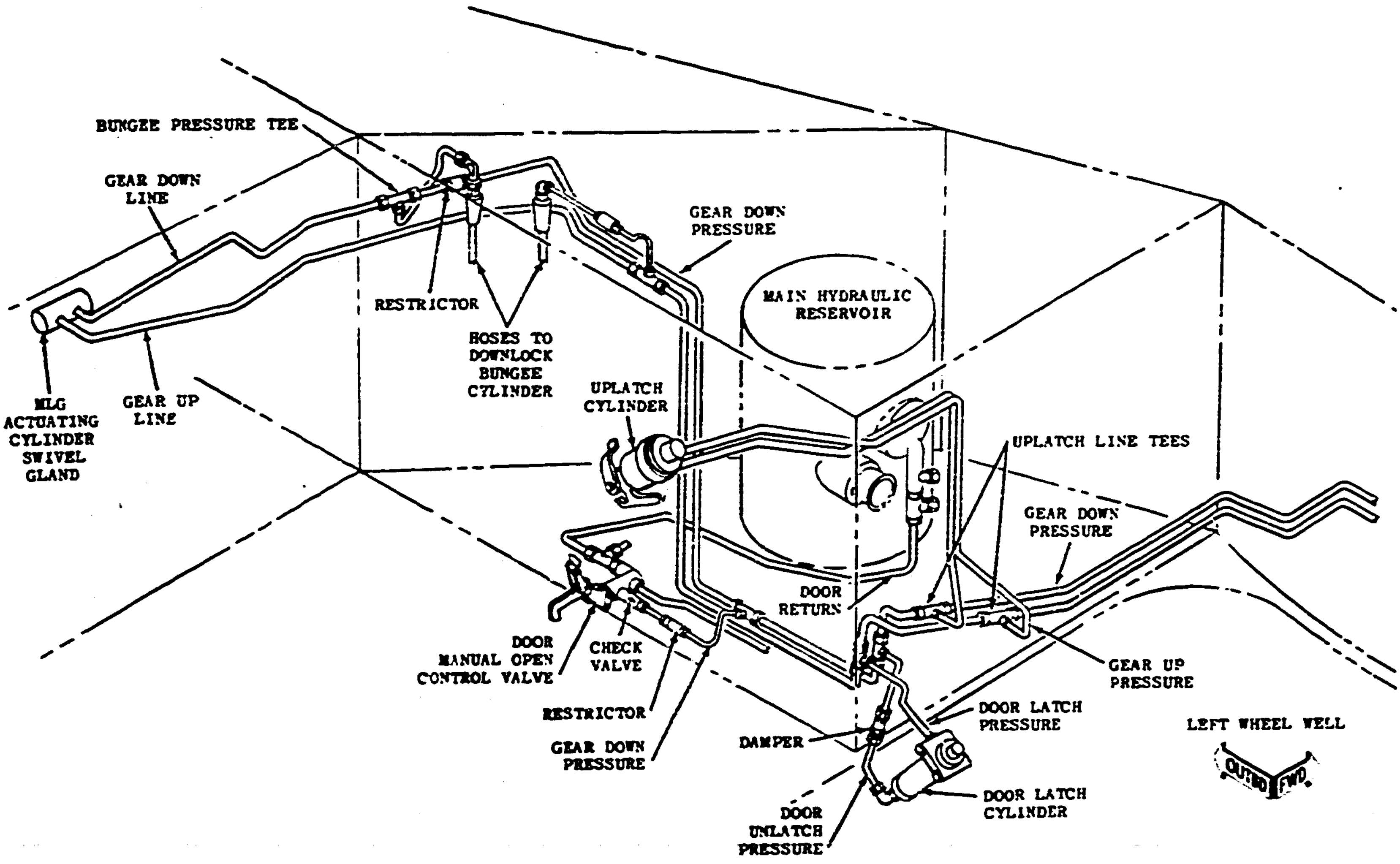
(14) Flush circuit for five minutes.

(15) Depressurize test stand.



H2-5038

Flushing Procedure Line Connection Locations
Figure 620



H2-5064

Flushing Procedure Line Connection Locations
Figure 621

(16) Inspect, clean, and/or replace actuating cylinder and attaching swivel gland, door latch assembly and attaching lines (which include damper), downlock bungee cylinder and connecting lines including 2 hoses, restrictors and several short lines.

(17) Disconnect gear uplatch lines from gear uplatch cylinder and connect jumper between lines.

(18) Connect this circuit to test stand pressure and return hoses and flush for 3 minutes. Use same pressure as in Step (13).

(19) Inspect, clean, and/or replace main gear uplatch cylinder.

(20) Restore all lines and units on left side of airplane to original configuration.

(21) Connect test stand pressure hose to right gear down line, and test stand return hose to right gear up line. These lines were capped in Step (5).

(22) Repeat Steps (6) through (20) for right side of airplane.

(23) Make any necessary adjustments per Chapter 32.

D. Main Gear Door System

(1) Disconnect right main gear door lines from bulkhead tees in center web of airplane. Cap tees.

(2) Disconnect pressure and return lines from left door actuating cylinder swivel gland. Place jumper across these lines.

(3) Disconnect door return line from inboard side of door manual open valve. Connect line to test stand return hose.

(4) Disconnect door pressure line from main gear control valve. Connect line to test stand pressure hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for three minutes.

(7) Depressurize test stand.

(8) Disconnect pressure and return lines from right door actuating cylinder swivel gland. Connect jumper across these lines.

(9) Connect test stand pressure and return hoses to lines that were capped in Step (1).

(10) Repeat Steps (5) through (7) for these lines.

(11) Inspect, clean, and/or replace both door actuating units, lines, and swivel glands.

(12) Inspect, clean, and/or replace door manual open valve, short line between manual open valve and tee in down line (this line includes restrictor and check valve), and line which runs from tee in manual open valve to reservoir fitting.

(13) Restore all lines and units to original configuration, and make any necessary adjustments per Chapter 32.

E. Bogie Trim and Bogie Swivel Unlock Systems (See Figure 622.)

(1) Disconnect both bogie unlock lines, and bogie trim pressure line from bogie swivel unlock control valve located on left power manifold.

(2) Connect test stand pressure hose to bogie trim pressure line, and test stand return hose to left bogie unlock line.

(3) Disconnect bogie trim pressure line, which leads to right gear, at tee located below left power manifold and to left of airplane centerline. Cap tee.

(4) Disconnect line, which runs from tee in bogie relief valve to tee in bogie trim pressure line, at bogie trim pressure line. Cap tee.

(5) Disconnect line with check valve, which runs from tee in bogie relief valve to tee in bogie unlock line, at bogie unlock cylinder. Cap tee.

(6) Install jumper lines around main gear swivel gland in bogie trim pressure line and bogie unlock line.

(7) Disconnect bogie trim pressure hose from tee in forward manifold, located on shock strut above bogie beam. Cap tee.

(8) Disconnect both hoses from bogie unlock cylinder and jumper these hoses together.

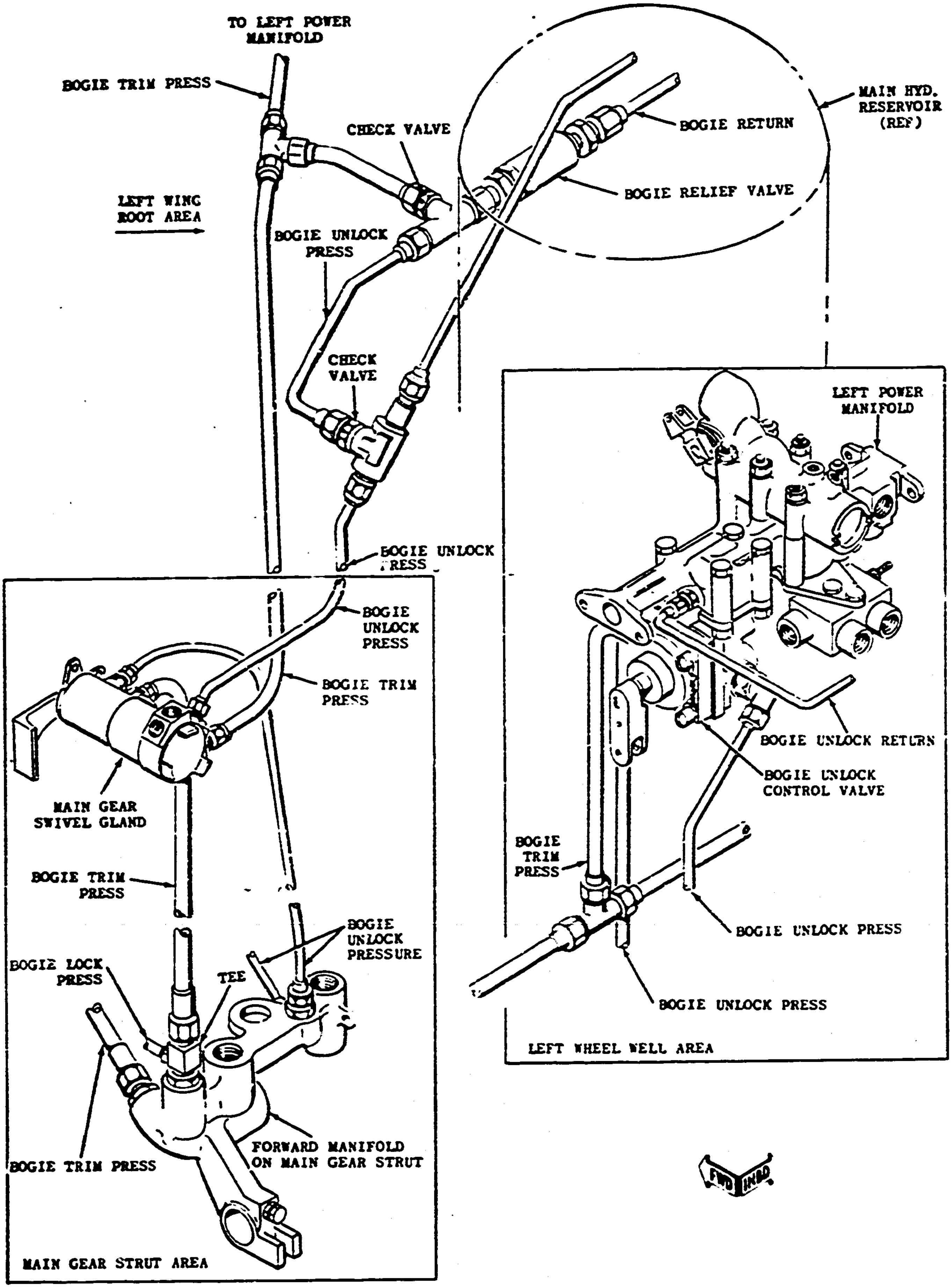
(9) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(10) Flush circuit for five minutes.

(11) Depressurize test stand.

(12) Inspect, clean, and/or replace bogie swivel unlock valve, bogie relief valve and check valve, three short lines which lead to tees in bogie trim pressure line, bogie unlock line, manual door open valve on left side of airplane, and tee in antiskid valve on right side of airplane.

(13) Inspect, clean, and/or replace swivel gland, located at top of main gear strut, bogie swivel unlock cylinder, and bogie trim cylinder with attaching hose and line.



E2-5067

Flushing Procedure Line Connection Locations
Figure 622

(14) Connect right bogie trim pressure line to tee from which it was disconnected in Step (3). Disconnect left bogie trim pressure line from this tee, and cap tee.

(15) Disconnect test stand return hose from left bogie unlock line and connect it to right bogie unlock line.

(16) Repeat Steps (4) through (13) for right side of airplane.

(17) Restore all lines, hoses, and units to original configuration. Make adjustments as necessary per Chapter 32.

F. Nose Gear System (See Figures 623 and 624.)

(1) Disconnect nose gear down line from tee in nose gear control valve. Connect line to test stand pressure hose.

(2) Disconnect actuating cylinder gear down hose from tee in gear down line, located on left side of nosewheel well. Cap tee.

(3) Jumper check valve in steering pressure line, which runs from tee for actuating cylinder down hose to tee which branches to reserve accumulator shutoff valve and pressure line running forward.

(4) At tee between check valve, removed in Step (3), and reserve accumulator shutoff valve, disconnect steering pressure line which leads forward. Cap tee.

(5) Disconnect pressure line from left side of reserve accumulator shutoff valve. Place jumper between this line and line which was disconnected in Step (4).

(6) Replace check valve in steering pressure line, located aft of nosewheel steering valve, with jumper.

(7) Disconnect all four lines from steering control valve. Place jumpers between pressure line and steer right line, and between return line and steer left line.

(8) Disconnect three 1/2-inch lines, and two 3/8-inch lines from swivel gland located on cross arm. Place jumper across two open steer left lines, located on opposite sides of swivel gland. Place jumper across two steer right lines, which were disconnected from same tee in swivel gland.

(9) Disconnect at steering cylinder glands, three steering lines which run from swivel gland on crossarm to glands at steering cylinders.

(10) Install jumper across two lines on right cylinder. On left cylinder install jumper from open line to open steer-right line upstream of swivel gland on crossarm.

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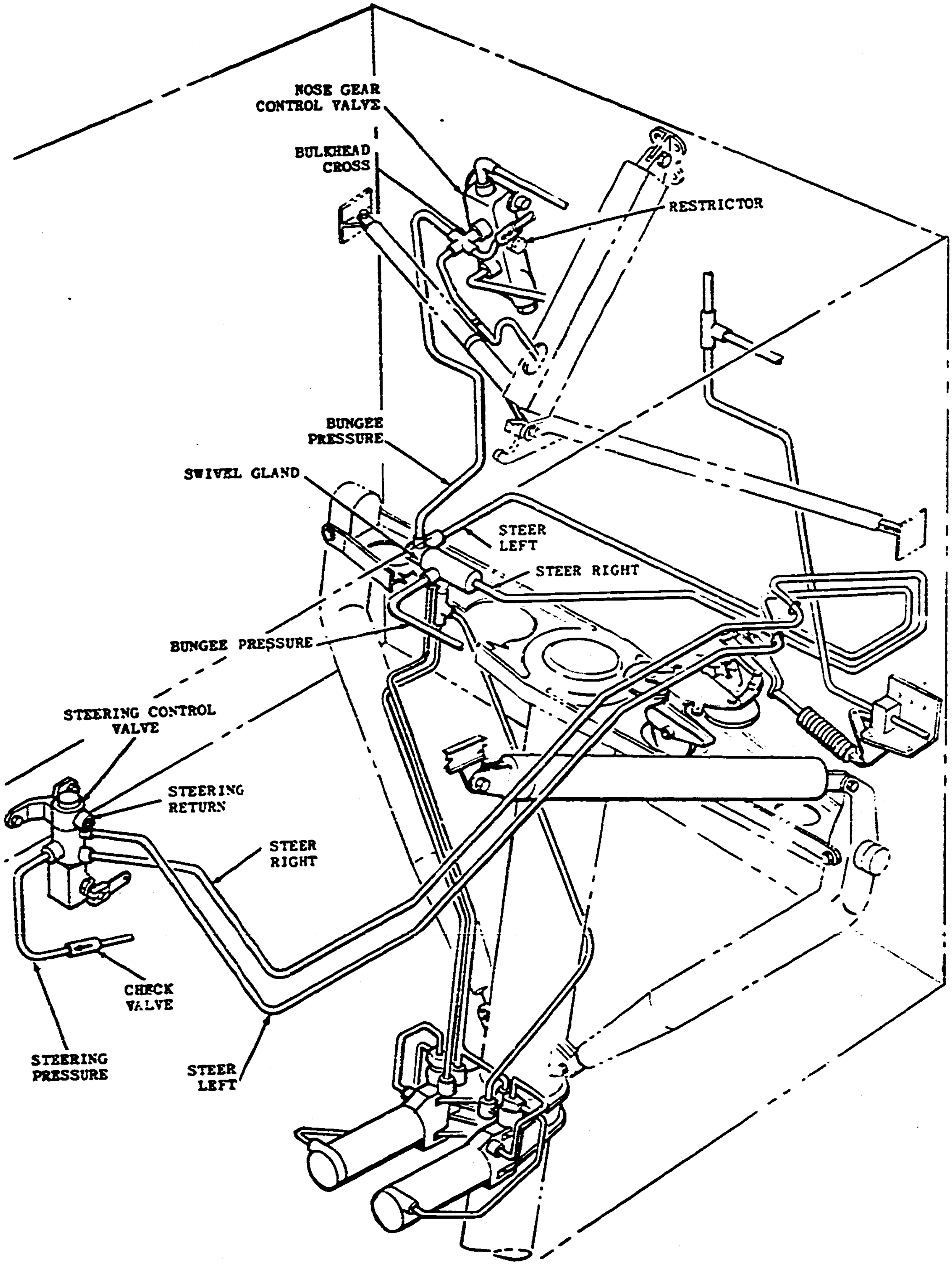


H2-5078A

Flushing Procedure Line Connection Locations
Figure 623

(11) Disconnect steering return line from lower side of tee in steering relief valve. Disconnect gear actuating cylinder up hose at cylinder. Place jumper between this open line and hose.

(12) Disconnect 1/4-inch up line from restrictor on side away from control valve. Disconnect 1/4-inch bungee line at bulkhead cross fitting at control valve. Place jumper across these two open lines.

(13) Disconnect bungee line from top of swivel gland and connect to test stand return hose.

(14) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(15) Flush circuit for five minutes.

(16) Depressurize test stand.

(17) Inspect, clean, and/or replace relief valve, bleeder valve, return accumulator and two associated lines, nose gear actuating cylinder and attaching hoses, bungee cylinder and attaching line, swivel gland mounted on crossarm, uplatch cylinder and two lines which connect it to control valve.

(18) Inspect, clean, and/or replace nosewheel steering valve, located on outboard side of left side of wheel well.

(19) Inspect, clean, and/or replace nosewheel steering cylinders, restrictors, and gland assemblies and associated lines; nosewheel steering control valve, reserve accumulator shutoff valve and associated lines, and check valves.

(20) Restore all lines and units to original configuration, and make any necessary adjustments as described in Chapter 32.

G. Ejector System (Airplanes 801-811.)

(1) Disconnect extend and retract lines at left outboard ejector solenoid valve.

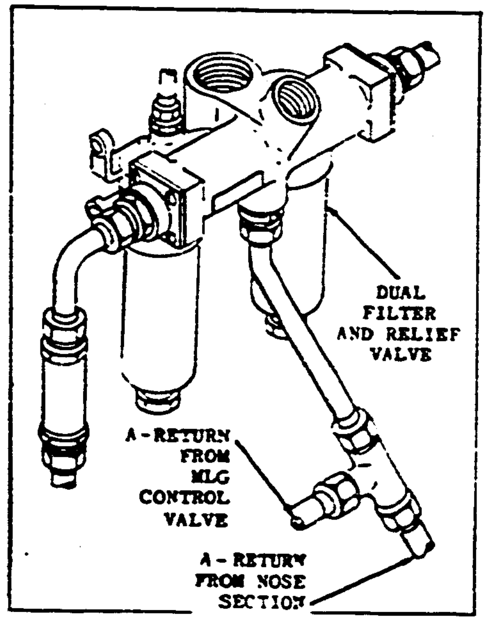
(2) Connect extend line to test stand pressure hose. Connect retract line to test stand return hose.

(3) Disconnect extend and retract lines at ejector cylinder and place jumper across lines.

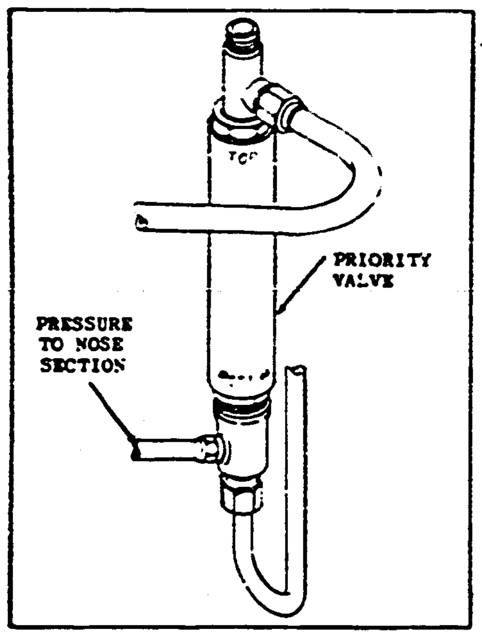
(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

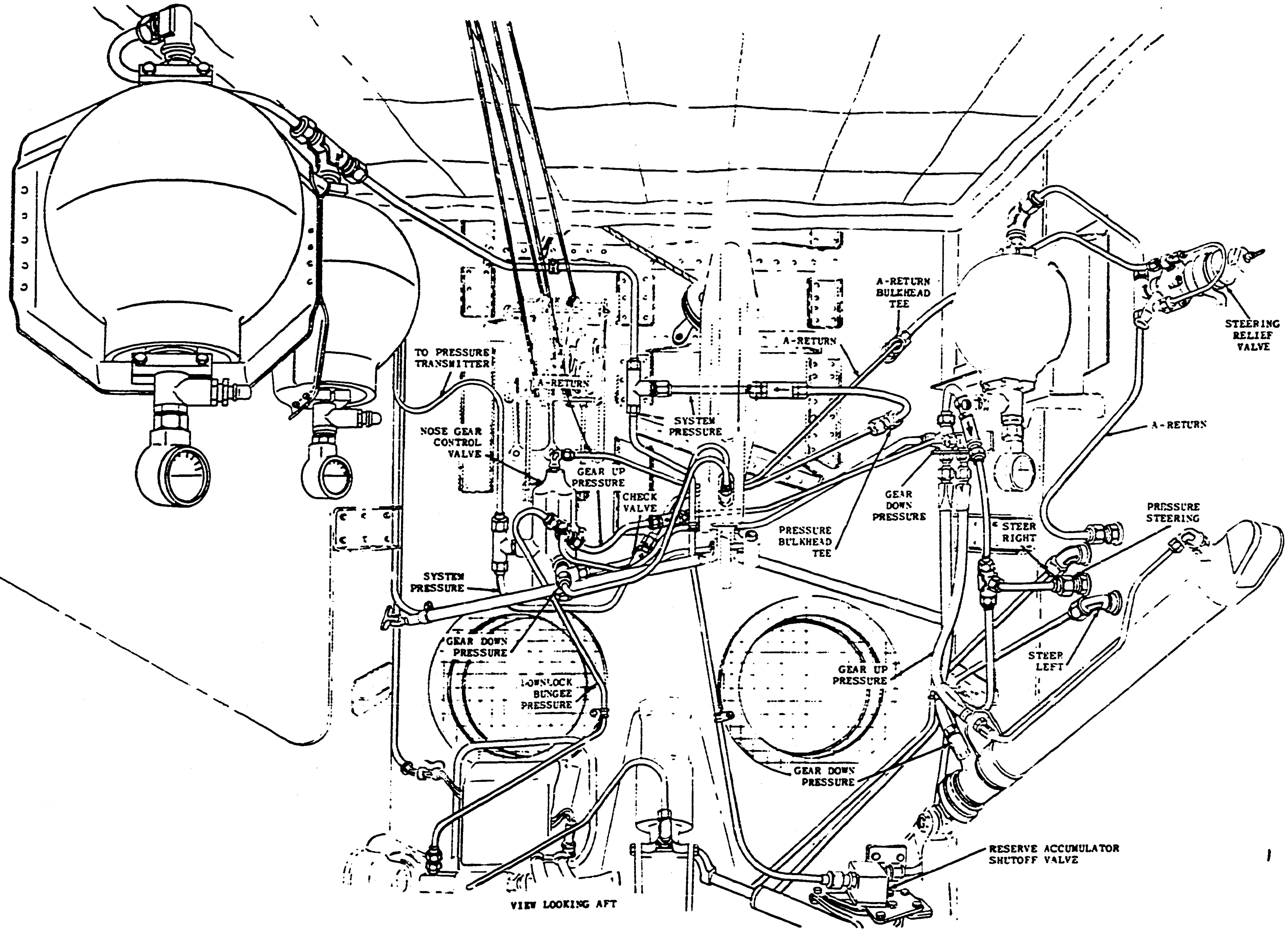
(6) Depressurize test stand.



VIEW LOOKING FORWARD IN LEFT WHEEL WELL (LOWER)



VIEW LOOKING FORWARD IN LEFT WHEEL WELL (CENTER)



VIEW LOOKING AFT

H2-5045

Flushing Procedure Line Connection Locations
Figure 624

(7) Inspect, clean, and/or replace ejector solenoid valve, restrictor, and ejector cylinder.

(8) Repeat Steps (1) through (7) for other three ejectors.

H. Brake System (See Figure 625.)

(1) Disconnect left brake pressure line from brake control valve, and connect to test stand pressure hose.

(2) Disconnect brake pressure inlet line and outlet line from left antiskid valve. Connect jumper across these lines.

(3) Install jumpers around forward brakes lockout cylinder and brake restrictor check valve.

(4) At left forward brakes, disconnect both brake pressure hoses. Cap inboard hose, and connect outboard hose to test stand return hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for three minutes.

(7) Depressurize test stand.

(8) Repeat Steps (4) through (7) for inboard hose on forward left brakes.

(9) Repeat Steps (2) through (7) for aft left brakes.

(10) Remove short B-return line, which runs from left antiskid valve to cross in B-return line at reservoir, and bench flush.

(11) Repeat Steps (1) through (9) for right side of airplane.

(12) In right wing root disconnect antiskid A-return line at tee in right antiskid valve and at tee in right aileron A-return line.

(13) Connect this line to test stand pressure and return hoses.

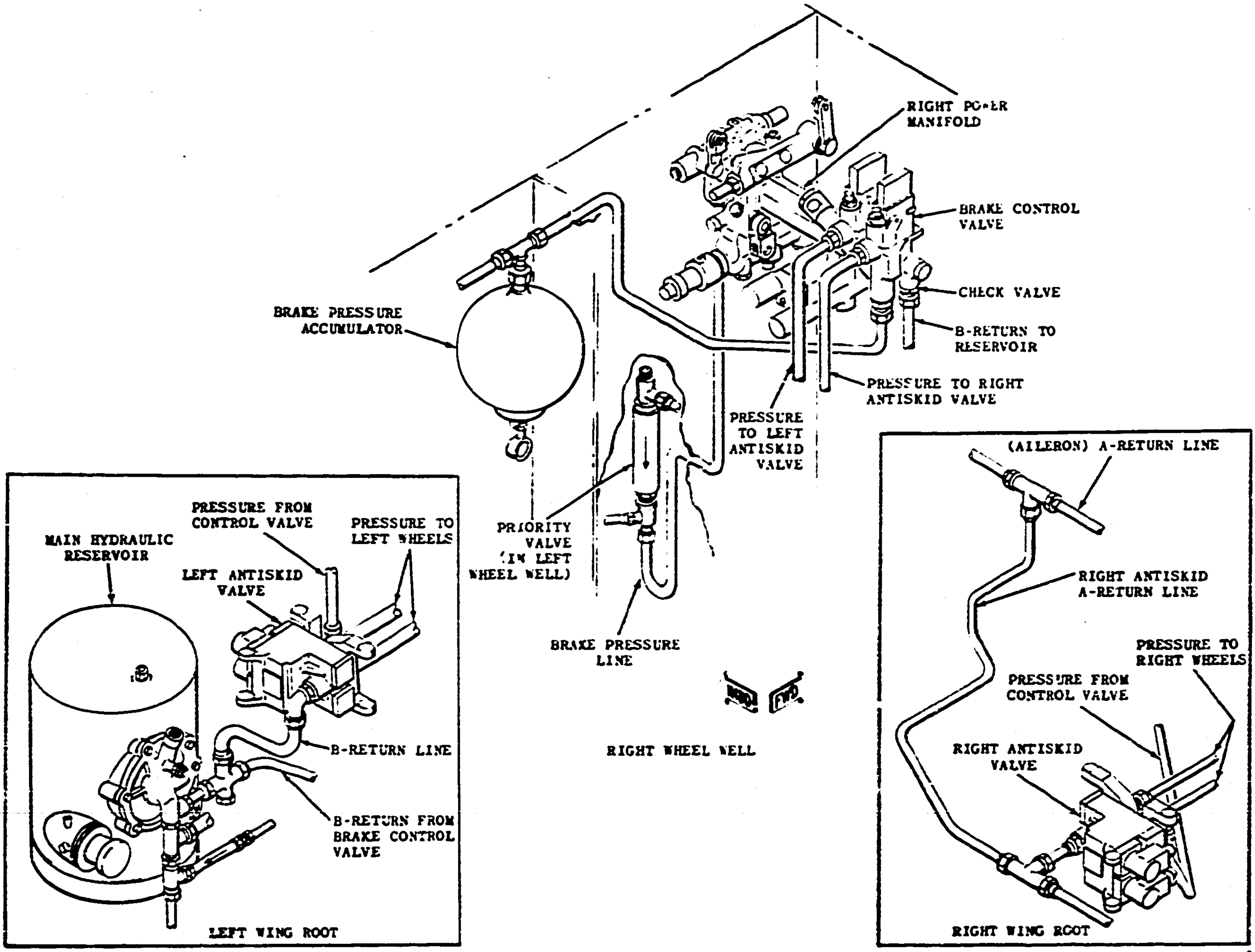
(14) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(15) Flush circuit for three minutes.

(16) Depressurize test stand.

(17) To flush brake accumulator and check valve system, disconnect pressure line which runs from right power manifold to tee on accumulator. Connect test stand return hose to line that was disconnected at accumulator tee.

(18) Remove brake inlet check valve seat, spring, and poppet from right power manifold. Install seat only with seals.



H2-5080

Flushing Procedure Line Connection Locations
Figure 625

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(19) Remove pressure line from tee at bottom of priority valve, located below left power manifold, and connect this line to test stand pressure hose.

(20) Pressurize test stand to 200 psi at 5 to 20 gpm flow.

(21) Flush circuit for five minutes.

(22) Depressurize test stand.

(23) Remove inlet check valve seat. Examine check valve assembly for evidence of improper seating and magnetization. Install new check valve assembly if required.

(24) Remove accumulators and connecting line. Clean and flush on bench.

(25) Inspect, clean, and/or replace brake valve, two antiskid valves, four lockout cylinders, and four restrictor check valves.

(26) Restore all lines and units to original configuration. Bleed and adjust brake system per Chapter 32.

8. Flush Flight Power Control Systems

A. Aileron Power System

(1) On left side of airplane, remove, inspect, clean and/or replace aileron power valve, power cylinder, lockout tab cylinder, and associated piping (including lines, glands, and restrictors) downstream of aileron filter and outboard of return manifold located at STA X_{rs} = -500.

(2) Repeat Step (1) for right aileron power system.

B. Rudder Power System

(1) In tail of airplane aft of pressure bulkhead, disconnect three horizontal stabilizer trim lines from tees in three rudder lines. Cap tees.

(2) On aft side of pressure bulkhead, disconnect B-return and low-pressure return lines. On downstream side of filter, disconnect empennage pressure line and connect it to test stand pressure hose.

(3) Connect jumper across open B-return and low-pressure return lines.

(4) Where rudder standby pressure line tees into normal pressure line, remove line and check valve. Cap tee.

(5) In same tee, mentioned in Step (4), remove other check valve in normal pressure line and replace it with jumper.

(6) Disconnect line which runs from check valve in shutoff valve to tee in B-return line at tee. Cap tee.

(7) At rudder shutoff valve, disconnect low-pressure return line from tee and connect to test stand return hose.

(8) At same valve, Step (7), disconnect pressure-in line and pressure-out line. Place jumper across two lines.

(9) Disconnect line from pressure reducer valve to tee in return line. Cap tee.

(10) At tee in pressure reducer valve, disconnect both pressure lines and connect together with jumper.

(11) Disconnect reduced pressure line from pressure reducer valve, and disconnect pressure line from restrictor check valve in rudder power cylinder swivel gland. Place jumper across these two open lines.

(12) Disconnect reduced pressure line from check valve in swivel gland, and disconnect return line from swivel gland. Place jumper across these two lines.

(13) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(14) Flush circuit for five minutes.

(15) Depressurize test stand.

(16) Inspect, clean, and/or replace rudder shutoff valve, pressure reducer valve, rudder power control cylinder, swivel gland, and all removed check valves and restrictors.

(17) Restore all lines and units to original configuration, and make any necessary adjustments per Chapter 27.

C. Horizontal Stabilizer Trim System

(1) Disconnect three stabilizer trim lines from tees in rudder power system lines.

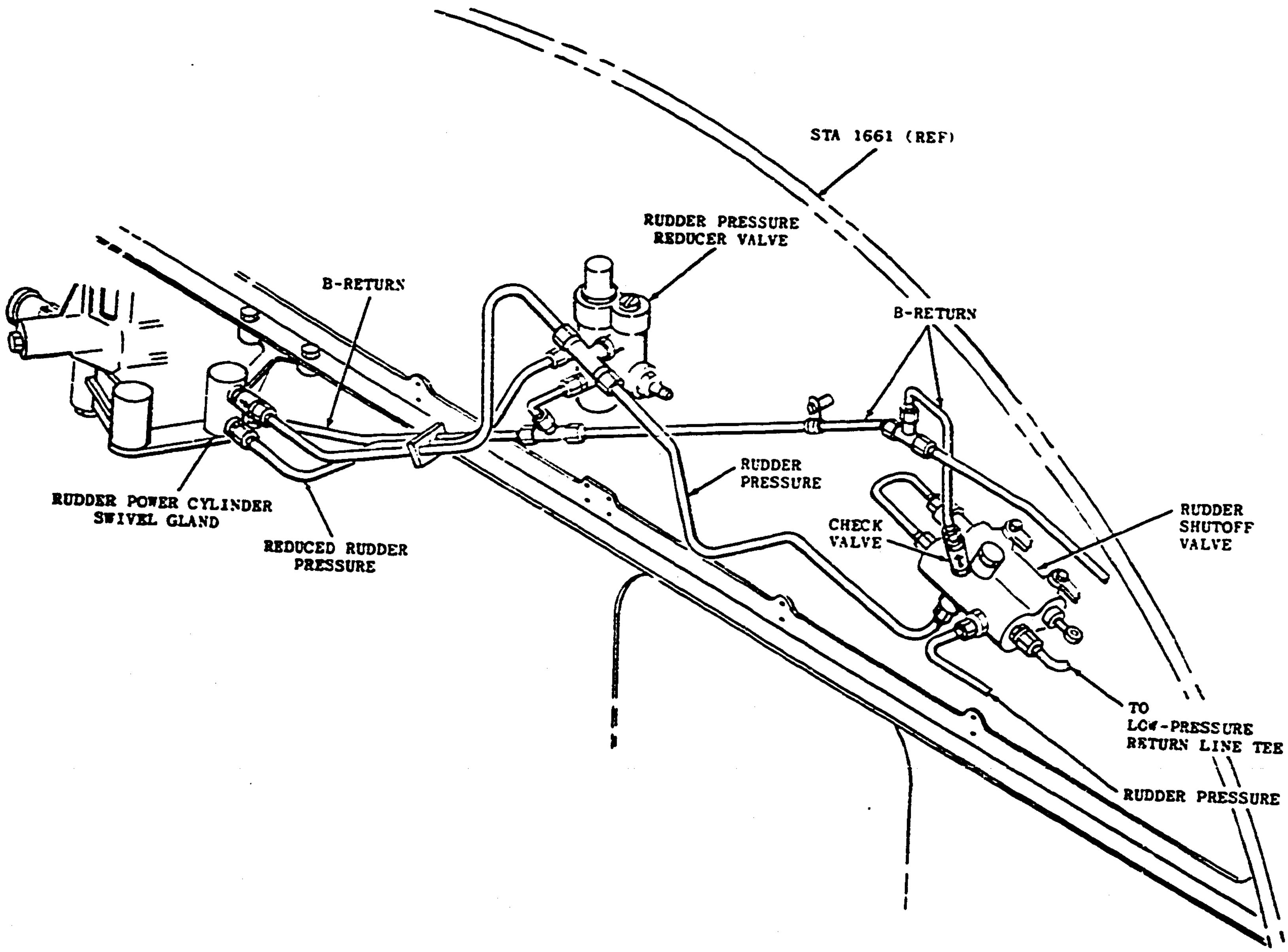
(2) Place jumper across B-return and low-pressure return lines.

(3) Connect open pressure line to test stand pressure hose.

(4) Disconnect low-pressure return line from trim motor control valve cross fitting. Disconnect B-return line from control valve. Disconnect pressure line from shutoff valve.

(5) Connect jumper between open pressure line, and open B-return line.

(6) Connect open low-pressure return line to test stand return hose.



H2-5036

Flushing Procedure Line Connection Locations
Figure 626

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for three minutes.

(9) Depressurize test stand.

(10) Inspect, clean, and/or replace hydraulic trim motor-brake, valves, and associated piping.

(11) Restore all lines and units to original configuration.

9. Flush Spoiler System

A. Spoiler Power System to Filter (See Figure 628.)

(1) After bleeding pressure and hydraulic fluid from spoiler system reservoir, disconnect bypass hose and pressure hose from bottom of pump. Connect two hoses together with union.

(2) At reservoir, disconnect suction hose and bypass hose. Jumper these two hoses together.

(3) Disconnect suction line from pump and connect to test stand pressure hose.

(4) Disconnect both pressure lines at tee in accumulator. Place jumper across these lines.

(5) At relief valve just forward of filter, disconnect pressure line from upper tee, and disconnect return line from forward side of bottom tee. Place jumper across open lines.

(6) Disconnect return line from tee in reservoir, and connect open line to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

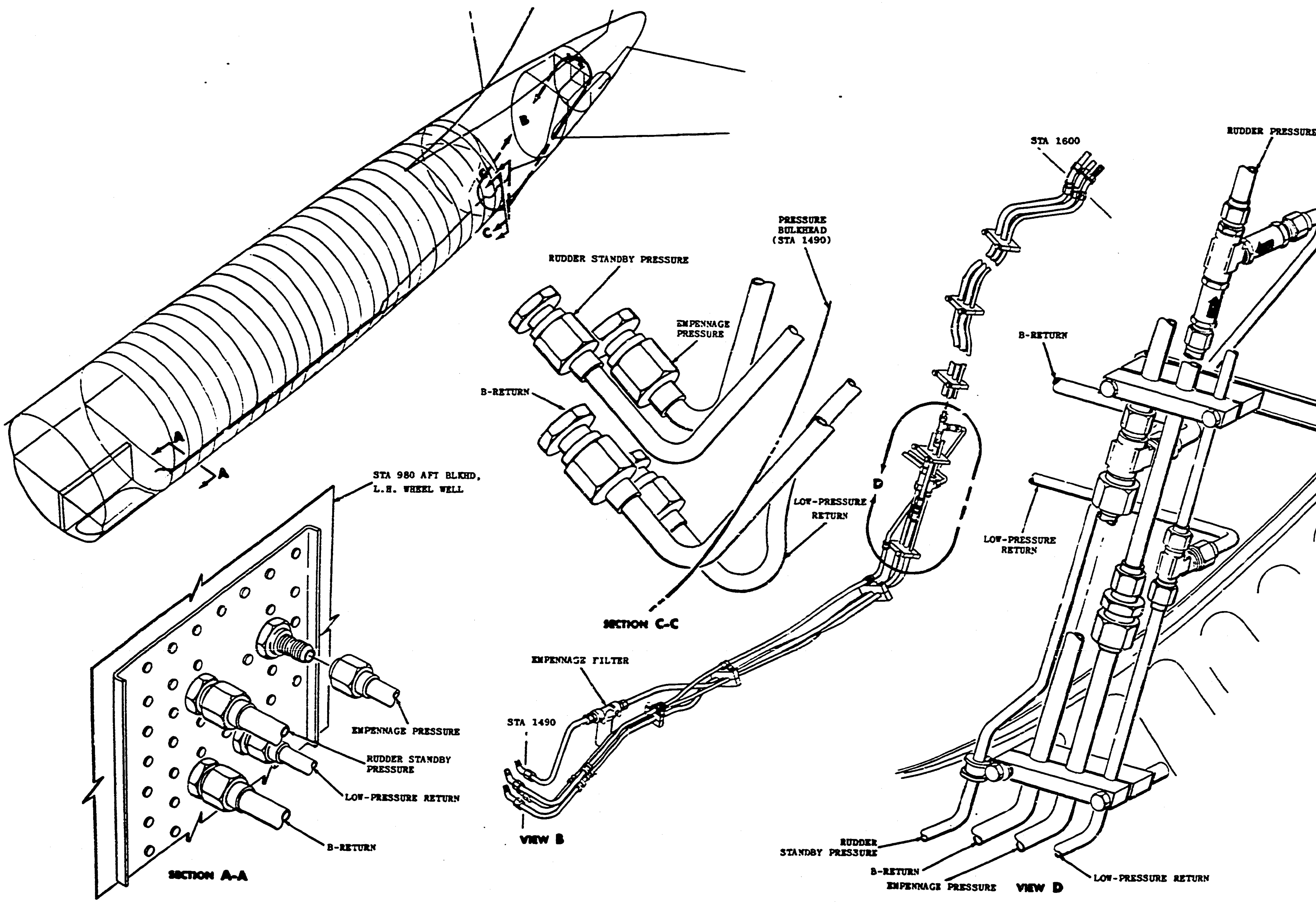
(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) Inspect, clean, and/or replace accumulator, and two relief valves (one at reservoir and one at filter).

(11) Clean out filter bowl and replace element.

(12) Clean out reservoir and refill with clean fluid after connecting all lines and units. Restore system to original configuration.



Flushing Procedure Line Connection Locations
Figure 627

B. Spoiler Supply System Filter to Units (See Figure 628.)

(1) Disconnect pressure line from check valve in spoiler system filter. Connect line to test stand pressure hose.

(2) Disconnect interconnect pressure line from tee in spoiler system pressure line. Cap tee.

(3) Following pressure line to next tee, disconnect line which runs forward. Cap tee.

(4) At pressure bulkhead tee in center web just forward of STA 980 (tee which supplies outboard spoiler pressure to both sides of airplane), disconnect line which runs to right. Cap tee.

(5) At STA X_{rs} = approx. 217 on both sides of airplane, disconnect spoiler pressure and return lines from spoiler glands. Place jumpers between these lines on both sides of airplane.

(6) At tee in return bulkhead tee, located just under pressure bulkhead tee mentioned in Step (4), disconnect both lines which run forward. Cap tee and place jumper across two lines.

(7) Disconnect return line from check valve in tee at bottom of system pressure relief valve. Connect this line to line disconnected in Step (4) with jumper.

(8) At spoiler valve, located on right power manifold, disconnect spoiler return line. From same manifold, disconnect spoiler pressure line. Connect these two lines together with jumper.

(9) Connect jumper line to line which was disconnected in Step (3). In same line at next tee forward, disconnect line which leads down to pressure transmitter and reservoir. Cap tee and connect open line to other end of jumper.

(10) Disconnect reservoir pressurization line from tee in pressure line. Disconnect pressure line from pressure transmitter. Connect two open lines with jumper, and cap tee.

(11) Disconnect reservoir pressurization line from bottom of reservoir, and connect line to test stand return hose.

(12) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(13) Flush circuit for five minutes.

(14) Depressurize test stand.

(15) Inspect, clean, and/or replace check valves in the filter, and in bottom of relief valve.

(16) Restore all lines and units to original configuration.

C. Outboard Spoiler System

(1) At STA X_{rs} = approx. 217, inspect, clean, and/or replace outboard spoiler cylinder and valve assembly, and connecting swivel glands.

(2) Restore all lines and units to their original configuration, and make any necessary adjustments per Chapter 27.

D. Inboard Spoiler System

(1) Disconnect extend and retract lines from spoiler control valve, located on right power manifold in right wheel well. Connect extend line to test stand pressure hose. Connect retract line to test stand return hose.

(2) At STA Y = 935 on right side of the center web, replace restrictor in spoiler retract line with jumper.

(3) In rear of left wheel well, disconnect extend and retract lines from inboard spoiler cylinder. Place jumper across open lines.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Inspect, clean, and/or replace spoiler control valve, two restrictors, and actuating cylinder.

(8) Restore all lines and units to original configuration, and make necessary adjustments per Chapter 27.

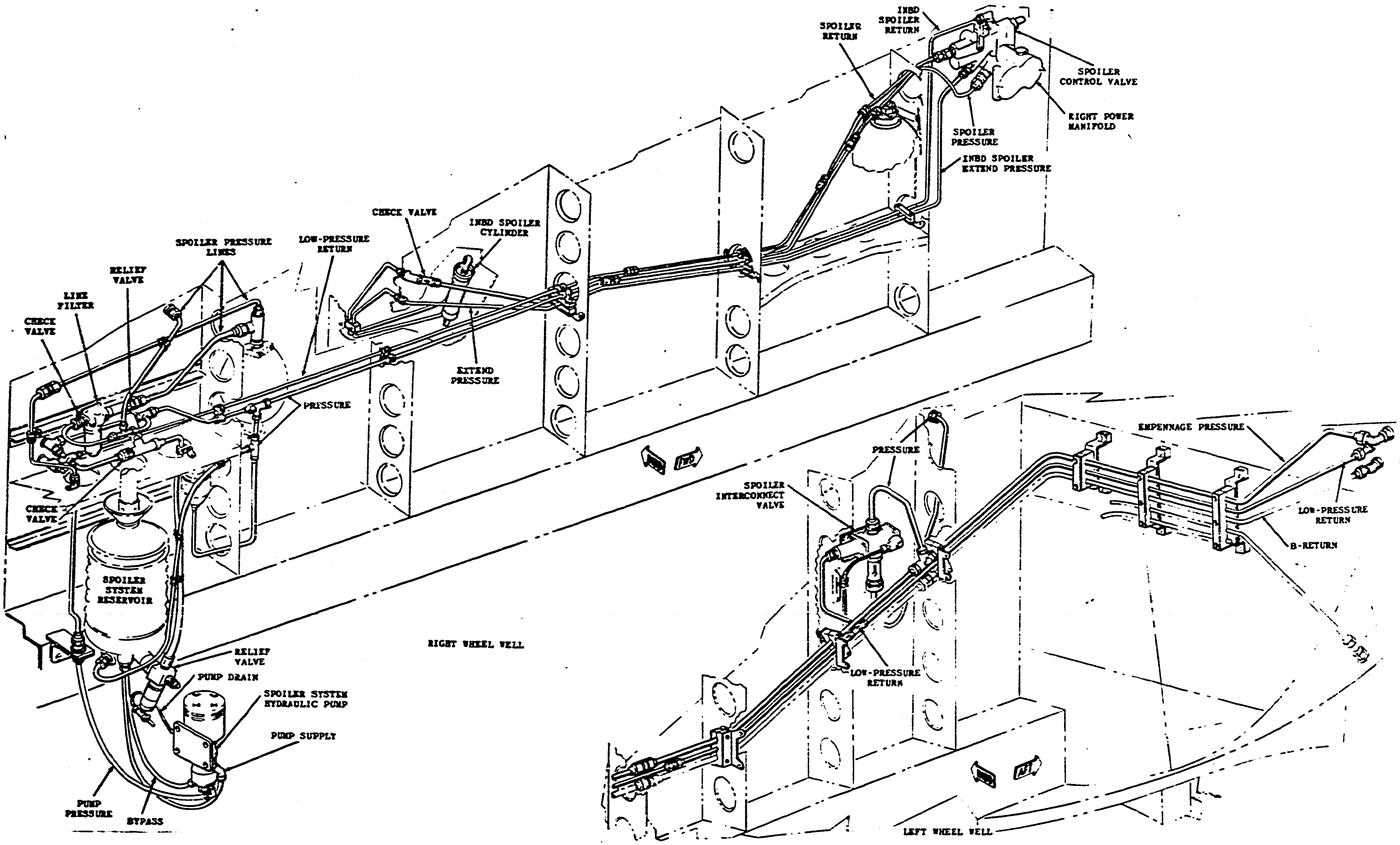
E. The Interconnect System

(1) In right wheel well, disconnect interconnect line from tee in spoiler system pressure line, located near spoiler system filter. Connect this line to test stand return hose.

(2) In left wheel well, disconnect three lines leading into solenoid interconnect valve, mounted on center web. Leave check valve with solenoid valve.

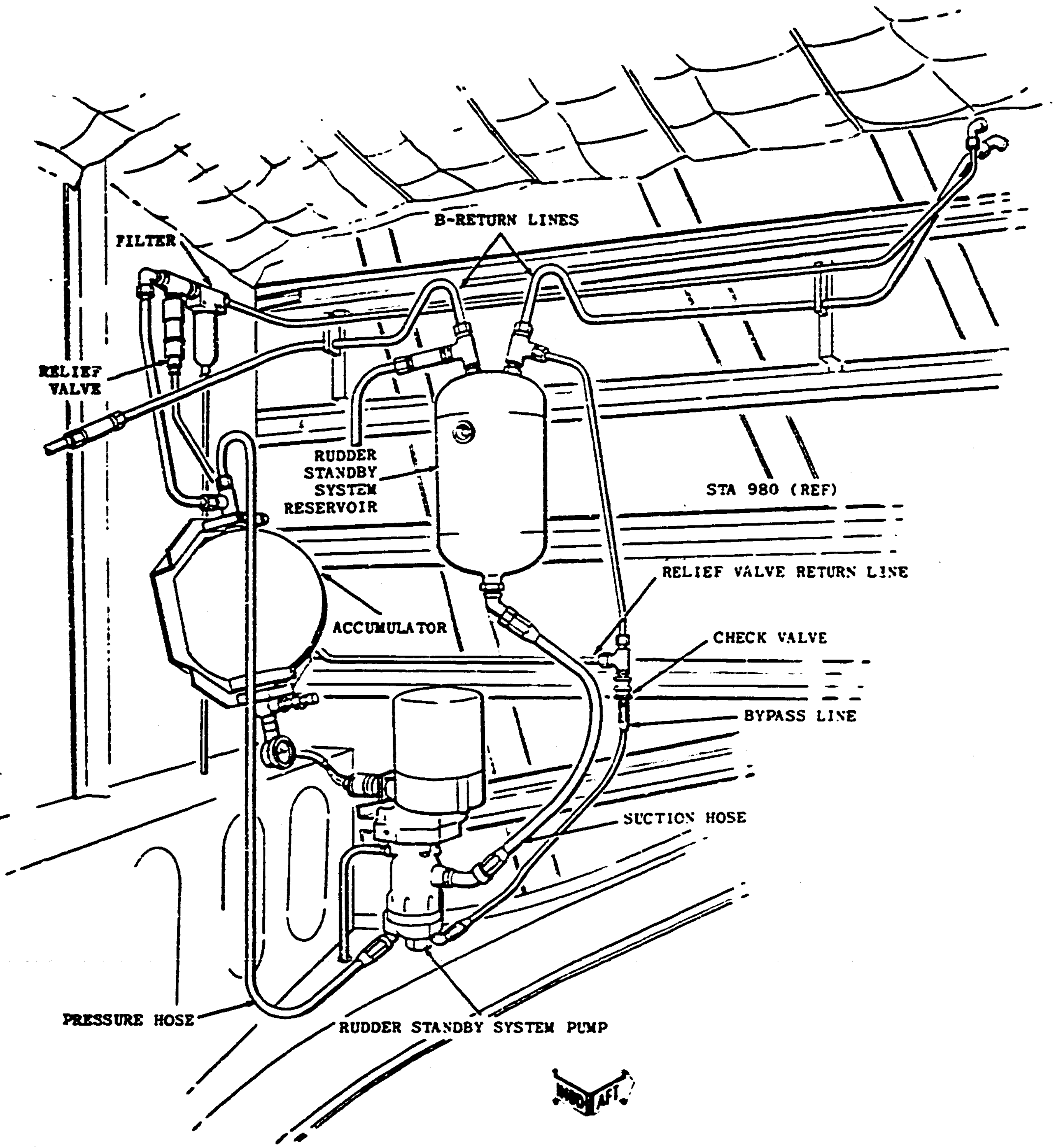
(3) Connect jumper between line disconnected from check valve and line disconnected from pressure port.

(4) Disconnect solenoid valve low-pressure return line from tee in empennage low-pressure return line. Connect this line to test stand pressure hose.



H2-5082

Flushing Procedure Line Connection Locations
Figure 628



INBOARD CORNER OF LEFT WHEEL WELL

H2-5037

Flushing Procedure Line Connection Locations
Figure 629

(5) Disconnect solenoid valve pressure line from tee in empennage pressure line. Connect this line to disconnected case drain line in solenoid interconnect valve with jumper.

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Inspect, clean, and/or replace solenoid interconnect valve, and check valve.

(10) Restore all lines and units to original configuration.

10. Flush Rudder Standby Hydraulic Power System (See Figure 629.)

A. Rudder Standby Power System To Filter

(1) In left wheel well just forward of STA 980, disconnect two B-return lines and bypass line from two tees in top of rudder standby system reservoir. Cap both openings in tee that had received bypass line.

(2) Connect opening in other tee to test stand pressure hose.

(3) Disconnect three hoses from rudder standby system pump. Connect suction hose to pressure hose.

(4) Disconnect 1/4-inch pressure line from tee in top of rudder standby system accumulator, and disconnect line in bottom of relief valve. Install jumper between these two lines.

(5) Disconnect relief valve return line and bypass line from tee fitting (with check valve), located on STA 980. Use bypass hose as jumper between these two lines.

(6) Connect bypass line, which was disconnected in Step (1), to test stand return hose.

(7) Pressurize test stand to 1200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) Inspect, clean, and/or replace the pump, accumulator, filter, relief valve, and check valve.

(11) Restore all lines and units to original configuration.

B. Rudder Standby Power Interconnect Line (Filter To Empennage Normal Power Line)

(1) In left wheel well, just forward of STA 980, disconnect rudder standby system pressure line from downstream side of filter. Connect this line to test stand pressure hose.

(2) In aft end of the airplane, disconnect rudder standby pressure line from check valve in tee located in normal rudder pressure line.

(3) This line may be attached directly to test stand return with long hose, or section of empennage return line may be connected into circuit for use with shorter test stand return hose.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Inspect, clean, and/or replace check valve mentioned in Step (2).

(8) Restore all lines and units to original configuration.

GENERAL - INSPECTION/CHECK

1. General

A. The DC8-60 Series airplane is provided with a main, a spoiler, and two auxiliary hydraulic systems. The auxiliary systems consist of the main auxiliary system, and the rudder standby system. All of these systems are subject to contamination which must be removed.

B. Contamination in the hydraulic sense may consist of foreign particles (metal, rubber, plastic, dirt, etc.), fluids other than hydraulic fluid, and damaged hydraulic fluid, which because of excessive heat and friction, no longer meets the minimum requirements.

C. The system filters ordinarily remove the minor contamination associated with normal wear. These filter elements are replaced at periodic inspections.

D. Contamination which requires a system or subsystem to be flushed is usually the result of:

(1) A damaged unit such as a pump failure.

(2) A malfunctioning unit or system, the nature of which lends suspicion to possible contaminated fluid.

(3) Overheated or diluted fluid, which does not meet minimum specification requirements.

E. The presence of contamination may be determined by:

(1) Checking the filter elements and bowls.

(2) Checking the magnetic drain plugs in the reservoirs and filters.

(3) Checking the fluid in the reservoirs.

(4) Taking samples of the fluid at various locations.

(5) Checking the individual components.

2. Isolation

A. The hydraulic subsystems may be isolated as follows:

(1) The main hydraulic power system is physically separated from the lateral control spoiler system.

(2) The lateral control spoiler system pump and supply is separated from the remainder of the lateral control system by a filter.

(3) The main hydraulic power system engine-driven hydraulic pump pressure lines are separated from the main system by the dual filter and relief valve assembly.

(4) The auxiliary hydraulic pump is separated from the main system by the auxiliary hydraulic pump filter.

(5) The aileron control valves and actuating cylinders are isolated from the main hydraulic power system by the aileron line filters.

(6) The empennage hydraulic power system is separated from the main hydraulic power system by the rudder filter.

(7) The filter in the main hydraulic system reservoir filters all returning fluid.

(8) A filter is installed in each engine-driven hydraulic pump low-pressure (case drain) return line to separate the pump return fluid from the main hydraulic system fluid and afford additional filtration prior to entering the reservoir filter.

(9) The rudder standby hydraulic system is separated from the main hydraulic power system by a filter and interconnect line.

(10) In addition to the filter divisions, the subsystems have been broken down into distribution and utility runs for ease of flushing and for isolation in specific cases where a known contamination source exists.

MAIN HYDRAULIC POWER SYSTEM (NORMAL AND AUXILIARY) -

INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the main hydraulic power system by flushing the system with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydr[illegible] hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings, as required by the following procedures.

3. Flush Main Hydraulic Power System (See Figure 601.)

A. Pressure Lines (Engine-Driven Pumps to Dual Filter and Relief Valve)

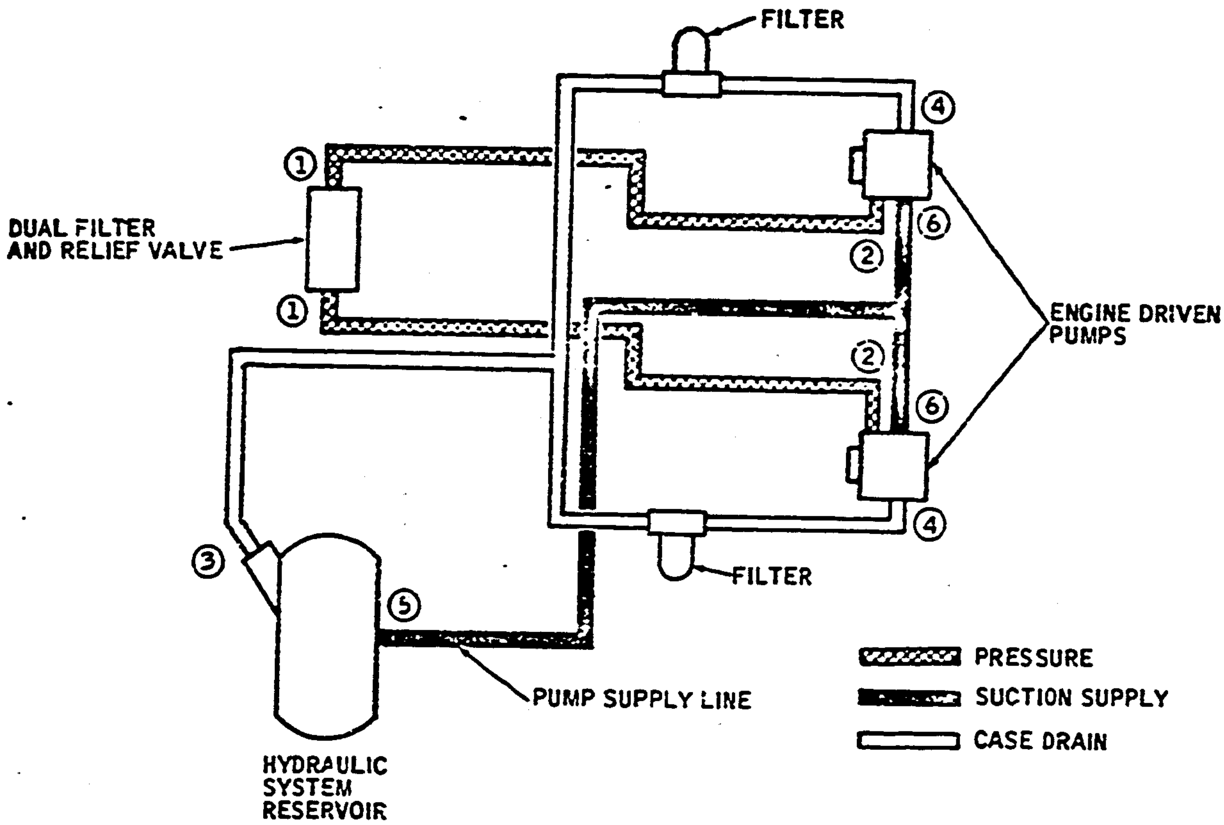
(1) Disconnect engine-driven hydraulic pump pressure hose from pump in No. 3 pylon.

(2) Disconnect pressure line from right side of dual filter and relief valve, located in left main gear wheel well.

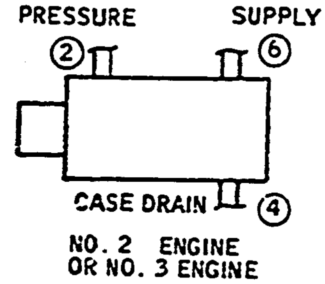
(3) At No. 3 pylon, replace check valve, located between engine pump hose and pressure line, with bulkhead fitting.

(4) Connect engine pump pressure hose to test stand pressure hose, and connect disconnected line at dual filter to test stand return hose.

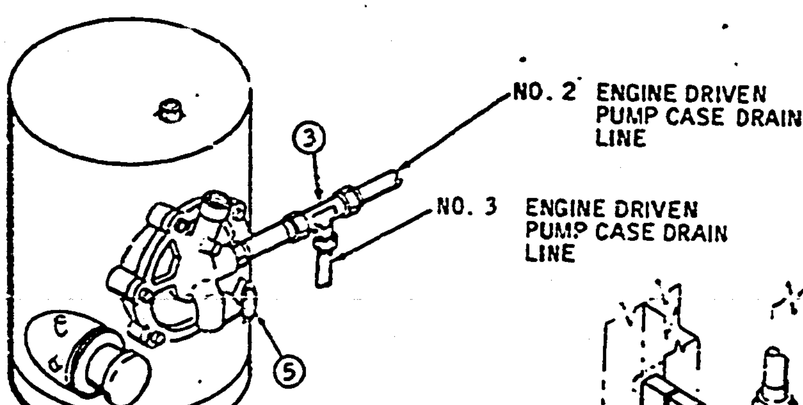
(5) Pressurize test stand to 200 psi at 5 to 20 gpm fluid flow.



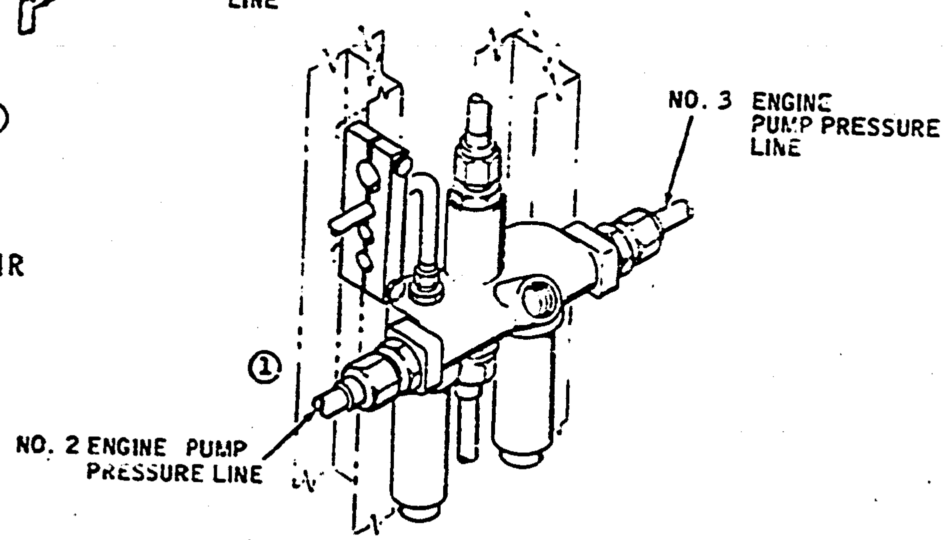
FLUSHING PROCEDURE SCHEMATIC



ENGINE DRIVEN PUMP



MAIN HYDRAULIC RESERVOIR



DUAL FILTER AND RELIEF VALVE

NOTE: THIS ILLUSTRATION DEPICTS FLUSHING BETWEEN POINTS 1 AND 2, 3 AND 4, 5 AND 6.

HA2-6082

Flushing Procedure Line Connection Locations
Figure 601

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(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Repeat steps (1 through 7) for pressure line between dual filter and No. 2 engine pump.

(9) Remove dual filter and relief valve filter elements, clean filter bowls, and install clean filter elements (see 29-10-17).

(10) Inspect, clean, and/or replace check valves.

(11) Restore all lines and units to original configuration.

B. Case Drain Lines

(1) Disconnect case drain hose from engine-driven pump in No. 3 pylon. Connect hose to hydraulic test stand pressure hose.

(2) At No. 3 pylon, replace check valve between engine-driven pump hose and case drain line with bulkhead fitting.

(3) At tee fitting, located in low-pressure return line adjacent to reservoir return port (see Figure 601), disconnect No. 2 engine pump case drain line. Cap tee fitting.

(4) Disconnect case drain line from low-pressure return port in reservoir, and connect this line to test stand return hose. Cap reservoir port.

(5) Disconnect lines from both sides of case drain filter and check valve, and jumper these return lines.

(6) Pressurize test stand to 200 psi maximum, at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Repeat steps (1 and 2) for engine pump in No. 2 pylon.

(10) Connect No. 2 engine pump case drain line, which was disconnected in step (3), to hydraulic test stand return hose.

(11) Repeat step (5) for No. 2 engine case drain filter and check valve.

(12) Repeat steps (6 through 8) for No. 2 engine pump case drain lines.

(13) Clean filter bowls and replace filter elements in case drain filters, located on rear spar (see 29-10-15).

(14) Inspect, clean, and/or replace check valves.

(15) Restore all lines and units to original configuration.

C. Reservoir and Suction System

(1) Do not disconnect or remove large reducer tee fitting and connecting supply lines from reservoir.

(2) Connect hydraulic test stand return hose to airplane ground service supply connection (see Figure 602).

(3) Drain reservoir, remove reservoir filter element (see 29-10-2). Clean out reservoir.

(4) Temporarily install reservoir filter cover plate with all return ports plugged.

(5) Disconnect aspirator line at reservoir end. Cap reservoir end and cap reservoir port.

(6) Disconnect suction hose from No. 2 engine-driven pump and connect test stand pressure hose to suction hose.

(7) Open fire shutoff valve on No. 2 engine.

(8) Disconnect and cap outboard flap return lines and port connectors where they connect to suction lines on rear spar, aft of No. 2 and No. 3 pylons (see Figure 602).

(9) Pressurize test stand to 45 psi at 20 gpm flow.

(10) Flush from engine pump suction hose to reservoir for five minutes.

<u>CAUTION:</u> WHEN FLUSHING THE SUPPLY LINES, MONITOR THE RESERVOIR FLUID LEVEL AND THE AIR PRESSURE GAGE ON TOP OF THE RESERVOIR AIR BLEED VALVE. THE FLUID LEVEL MUST BE VISIBLE IN THE SIGHT GAGE, AND THE PRESSURE MUST NOT EXCEED 45 PSI TO PREVENT DAMAGE TO THE RESERVOIR.

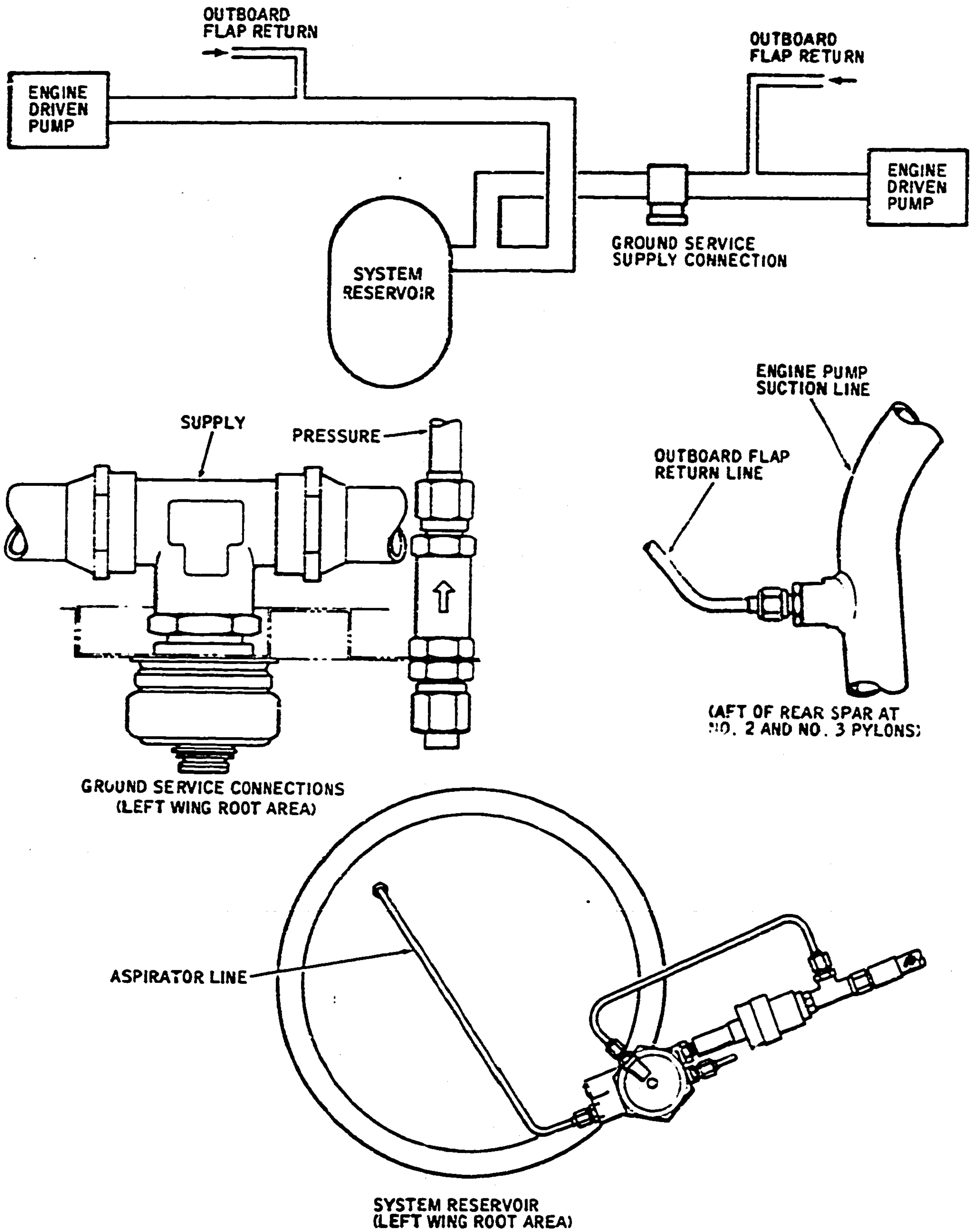
(11) Depressurize test stand.

(12) Close No. 2 and No. 3 engine fire shutoff valve.

(13) Remove test stand pressure hose from No. 2 engine pump supply line, and connect No. 3 engine-driven pump supply line. Open No. 3 engine fire shutoff valve.

(14) Repeat steps (9 through 11).

(15) Close No. 3 engine fire shutoff valve and disconnect test stand from engine-driven pump suction supply hose.



Flushing Procedure Line Connection Locations
Figure 602

(16) Uncap aspirator line and reservoir aspirator port. Connect aspirator line to reservoir.

(17) Uncap outboard flap return lines and return line ports in pump suction lines and connect flap return lines to suction lines.

(18) Flush main hydraulic reservoir, air chamber, and associated lines as follows:

(a) Disconnect line which runs from air chamber to reservoir air relief valve, located downstream of air bleed valve in left wheel well (see Figure 603).

(b) Connect this line to test stand pressure hose.

(c) At same location, disconnect vent line which runs to tee fitting in reservoir filler neck. Cap line.

(d) At filler neck, disconnect both vent lines and connect together with jumper line.

(e) At tee in filler line, disconnect line which runs to high standpipe port at bottom of main reservoir (see Figure 604). Cap tee fitting and connect disconnected line to test stand return hose.

(f) Pressurize test stand to 45 psi maximum at 20 gpm flow.

(g) Flush circuit for five minutes.

(19) Depressurize test stand.

(20) Disconnect test stand pressure hose from overboard line and cap this line. Connect test stand pressure hose to vent line that was capped in step (18, c).

(21) Repeat steps (18, f and g).

(22) Depressurize test stand, drain and clean out reservoir. Install new reservoir filter element (see 29-10-2).

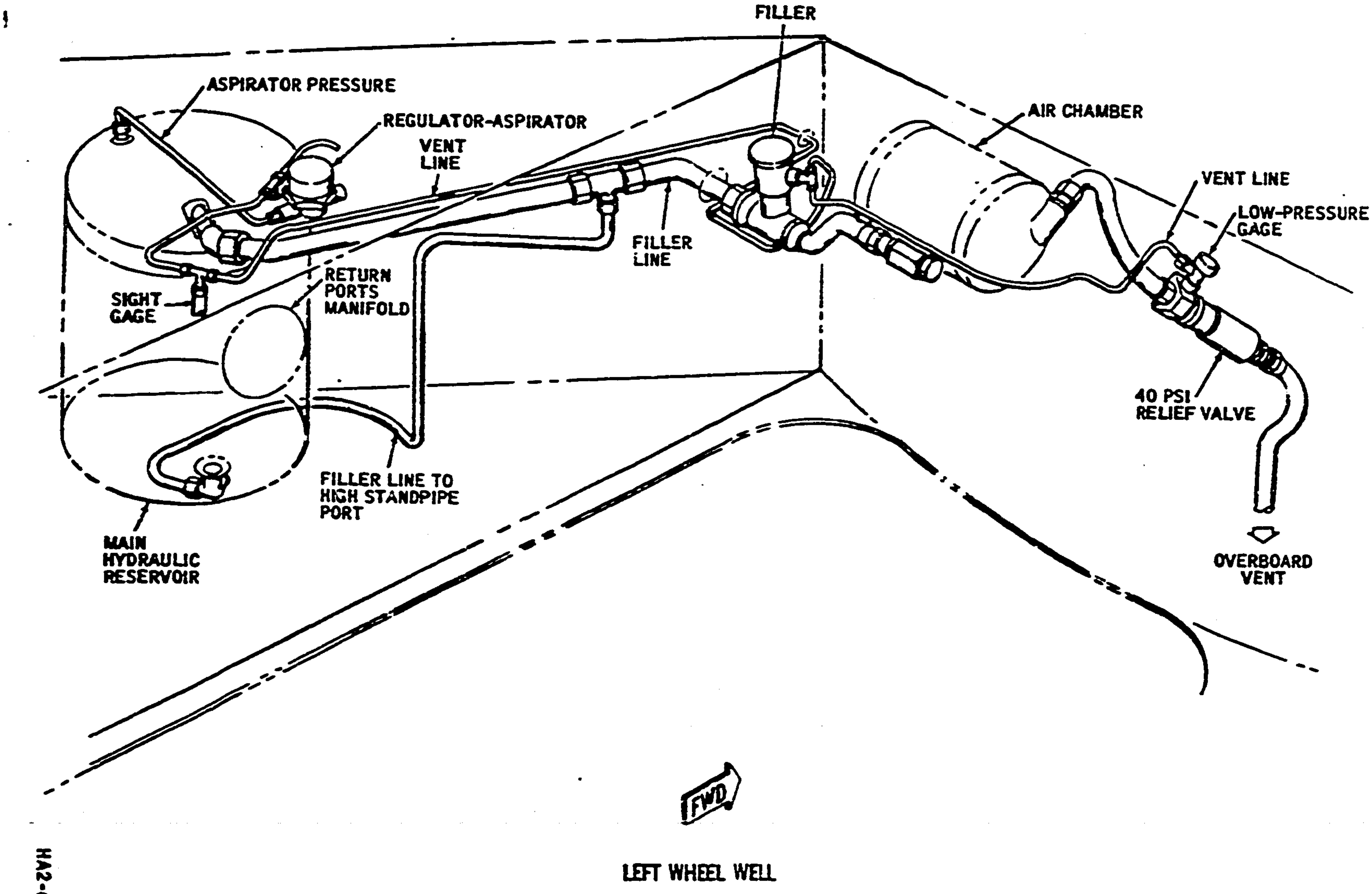
(23) Restore all lines and units to original configuration.

D. Auxiliary Hydraulic System Alternate Reservoir

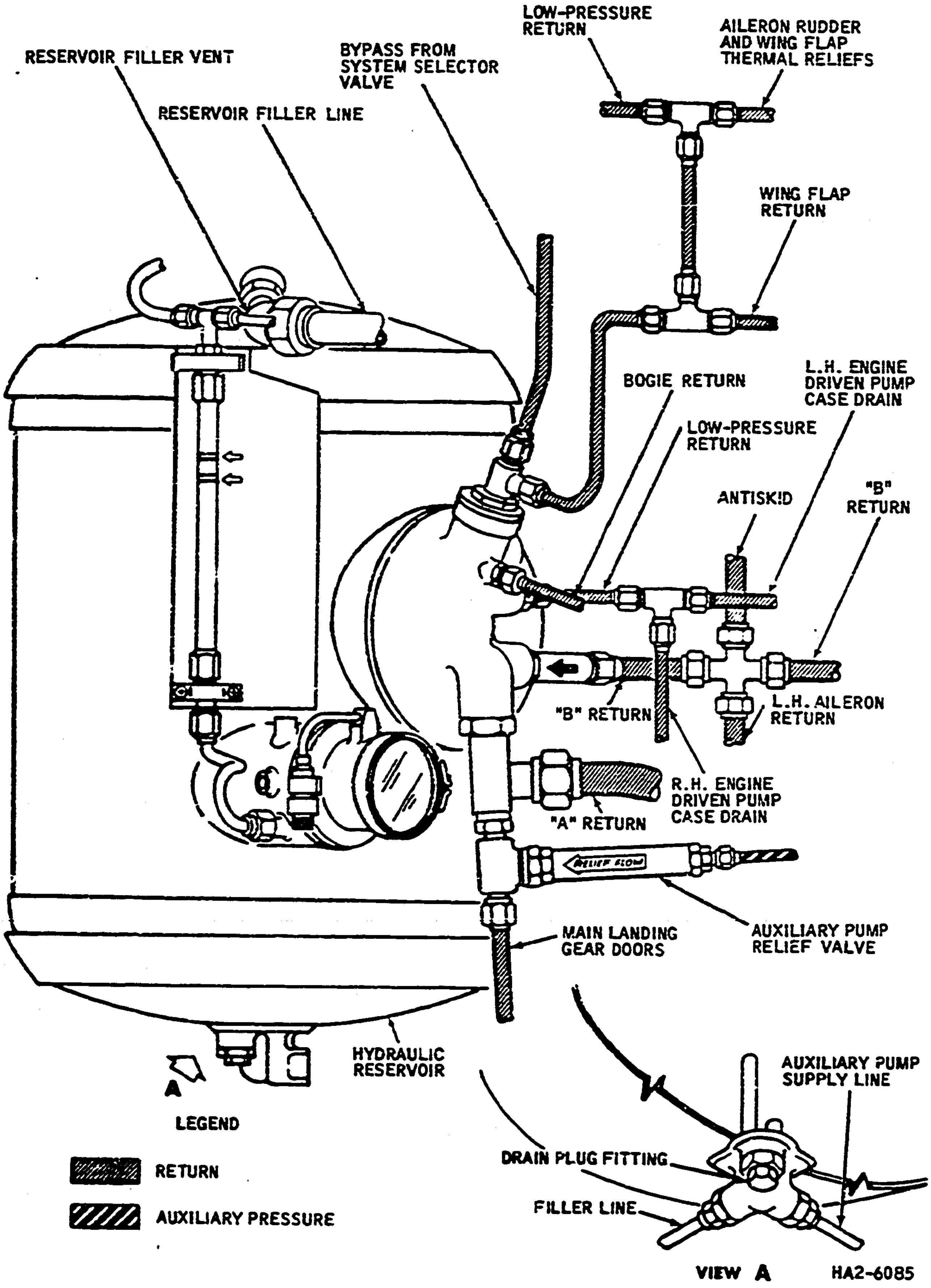
<u>NOTE</u>: The auxiliary pump alternate reservoir may be contaminated by the wing flap return line, the auxiliary pump bypass line, or the low-pressure return lines that tie into the wing flap lines.

(1) Disconnect wing flap return line from tee fitting upstream of low pressure return line (see Figure 604). Cap tee.

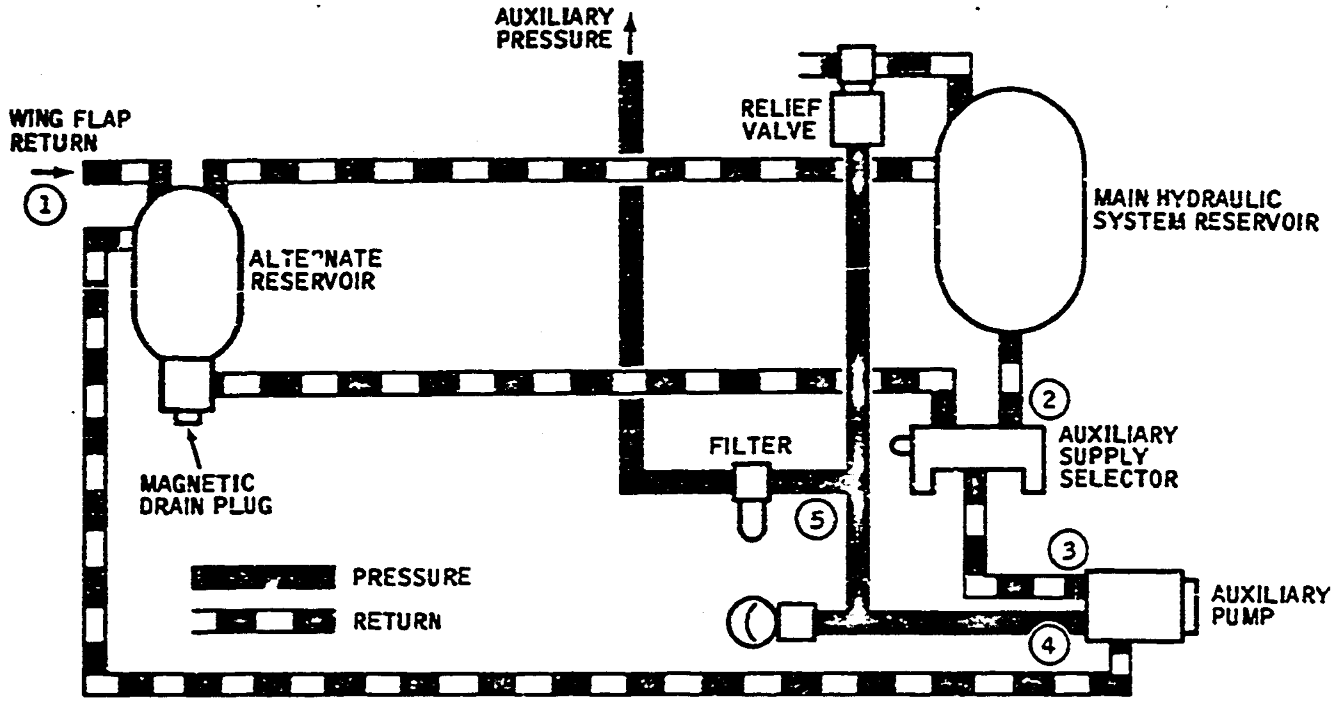
(2) Connect wing flap return line to test stand pressure hose.



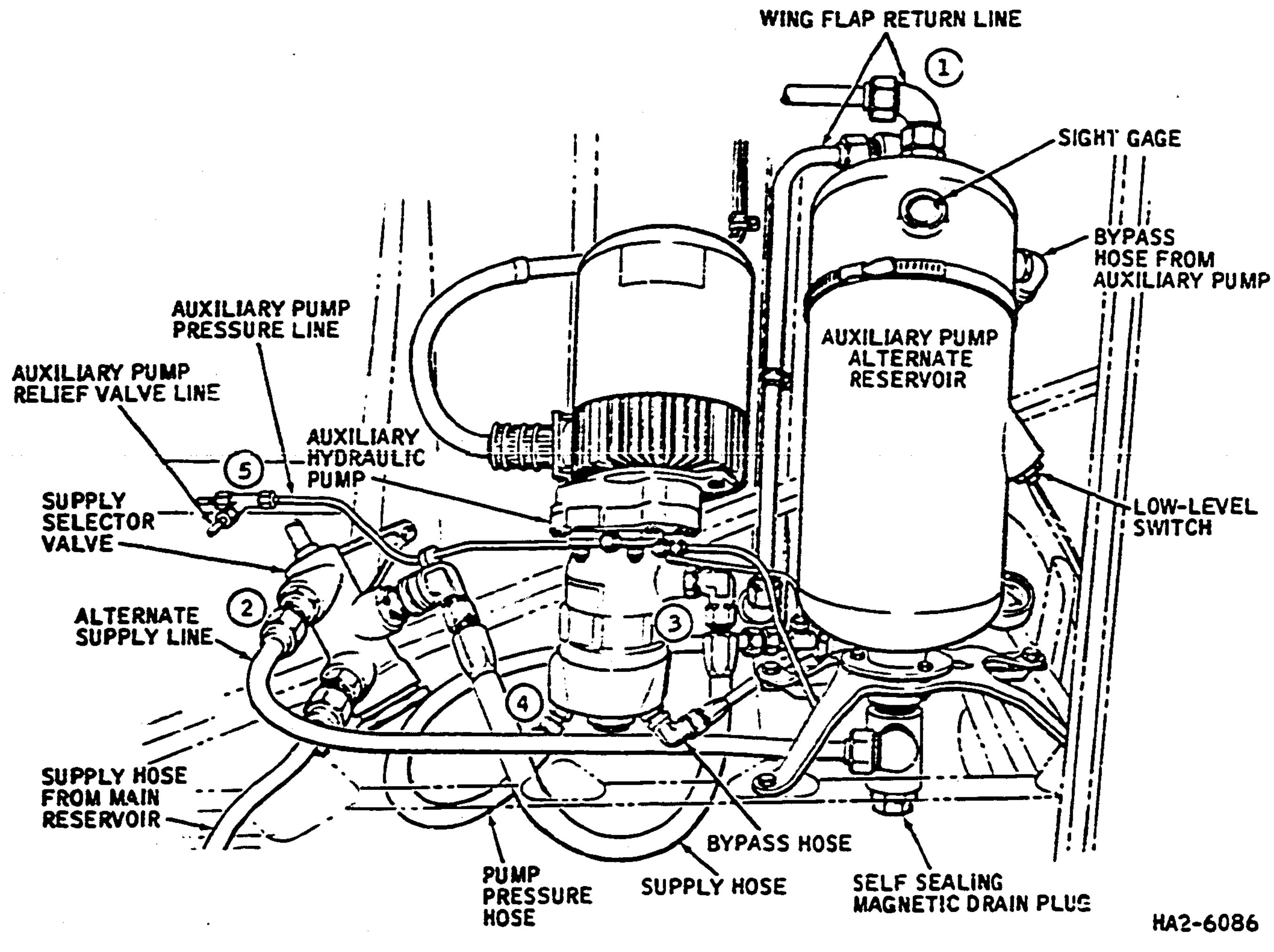
Flushing Procedure Connection Locations
Figure 603



Flushing Procedure Connection Locations
Figure 604



AUXILIARY HYDRAULIC PUMP SYSTEM



Flushing Procedure Line Connection Locations
Figure 605

(3) Disconnect alternate supply line from supply selector valve. Connect line to test stand return hose (see Figure 605).

(4) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand, and drain alternate reservoir (see 29-00, Maintenance Practices).

(7) Restore all lines to original configuration.

E. Auxiliary Hydraulic Pump System (See Figures 604 and 605.)

(1) Disconnect auxiliary pump supply line from low standpipe port in bottom of main reservoir. Cap reservoir port, and connect line to test stand pressure hose.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Disconnect auxiliary pump supply and pressure hoses from pump. Connect these two lines together.

(4) Disconnect auxiliary pump pressure line, and relief valve line from tee fitting located adjacent to auxiliary supply selector valve. Connect these lines together.

(5) Disconnect auxiliary pump relief valve inlet line from relief valve, located near A-return line of main reservoir. Connect line to test stand return hose.

(6) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Disconnect test stand pressure hose from auxiliary pump supply hose, and connect to supply selector valve alternate supply port.

(10) Place hydraulic system selector control lever in No. 3 position, and repeat steps (6 through 8).

(11) Remove auxiliary hydraulic pump case drain hose. Clean, and/or replace.

(12) Remove auxiliary pump filter element, clean filter bowl. Install clean filter element (see 29-[illegible]-5).

(13) Restore all lines and units to original configuration.

MAIN HYDRAULIC POWER SYSTEM (NORMAL AUXILIARY) - —

INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the main hydraulic power system by flushing the system with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings, as required by the following procedures.

3. Flush Main Hydraulic Power System (See Figure 601.)

A. Pressure Lines (Engine-Driven Pumps to Dual Filter and Relief Valve)

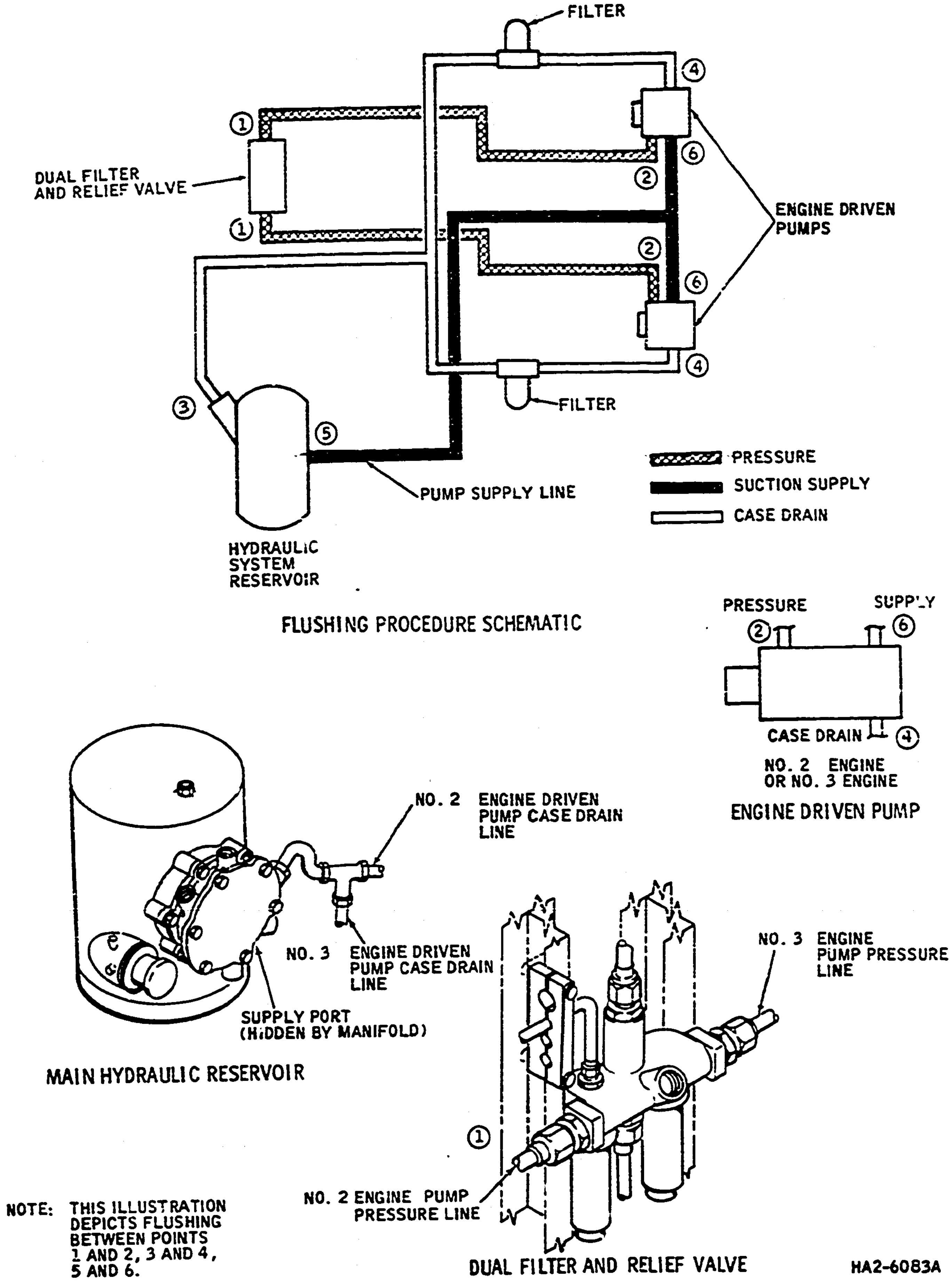
(1) Disconnect engine-driven hydraulic pump pressure hose from pump in No. 3 pylon.

(2) Disconnect pressure line from right side of dual filter and relief valve, located in left main gear wheel well.

(3) At No. 3 pylon, replace check valve, located between engine pump hose and pressure line, with bulkhead fitting.

(4) Connect engine pump pressure hose to test stand pressure hose, and connect disconnected line at dual filter to test stand return hose.

(5) Pressurize test stand to 200 psi at 5 to 20 gpm fluid flow.



Flushing Procedure Line Connection Locations
Figure 601

(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Repeat steps (1 through 7) for pressure line between dual filter and No. 2 engine pump.

(9) Remove dual filter and relief valve filter elements, clean filter bowls, and install clean filter elements (see 29-10-17).

(10) Inspect, clean and/or replace check valves.

(11) Restore all lines and units to original configuration.

B. Case Drain Lines

(1) Disconnect case drain hose from engine-driven pump in No. 3 pylon. Connect hose to hydraulic test stand pressure hose.

(2) At No. 3 pylon, replace check valve between engine-driven pump hose and case drain line with bulkhead fitting.

(3) At tee fitting, located in B-return line adjacent to reservoir return port (see Figure 601), disconnect No. 2 engine pump case drain line. Cap tee fitting.

(4) Disconnect case drain line from case drain return port in reservoir, and connect this line to test stand return hose. Cap reservoir port.

(5) Disconnect lines from both sides of case drain filter and check valve, and jumper these return lines.

(6) Pressurize test stand to 200 psi maximum, at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Repeat steps (1 and 2) for engine pump in No. 2 pylon.

(10) Connect No. 2 engine-pump case drain line, which was disconnected in step (3), to hydraulic test stand return hose.

(11) Repeat step (5) for No. 2 engine case drain filter and check valve.

(12) Repeat steps (6 through 8) for No. 2 engine pump case drain lines.

(13) Clean filter bowls and replace filter elements in case drain filters, located on rear spar (see 29-10-15).

(14) Inspect, clean, and/or replace check valves.

(15) Restore all lines and units to original configuration.

C. Reservoir and Suction System

(1) Do not disconnect or remove large reducer tee fitting and connecting supply lines from reservoir.

(2) Connect hydraulic test stand return hose to airplane ground service supply connection (see Figure 602).

(3) Drain reservoir, remove reservoir filter element (see 29-10-2). Clean out reservoir.

(4) Temporarily install reservoir filter cover plate. Disconnect and cap all return ports.

(5) Disconnect aspirator line at reservoir end. Cap reservoir end and cap reservoir port.

(6) Disconnect suction hose from No. 2 engine-driven pump and connect test stand pressure hose to suction hose.

(7) Open fire shutoff valve on No. 2 engine.

(8) Disconnect and cap outboard flap return lines and port connectors where they connect to suction lines on rear spar aft of No. 2 and No. 3 pylons. (see Figure 602).

(9) Pressurize test stand to 45 psi at 20 gpm flow.

(10) Flush from engine pump suction hose to reservoir for five minutes.

CAUTION: WHEN FLUSHING THE SUPPLY LINES, MONITOR THE RESERVOIR FLUID LEVEL AND THE AIR PRESSURE GAGE ON TOP OF THE RESERVOIR AIR BLEED VALVE. THE FLUID LEVEL MUST BE VISIBLE IN THE SIGHT GAGE, AND THE PRESSURE MUST NOT EXCEED 45 PSI TO PREVENT DAMAGE TO THE RESERVOIR.

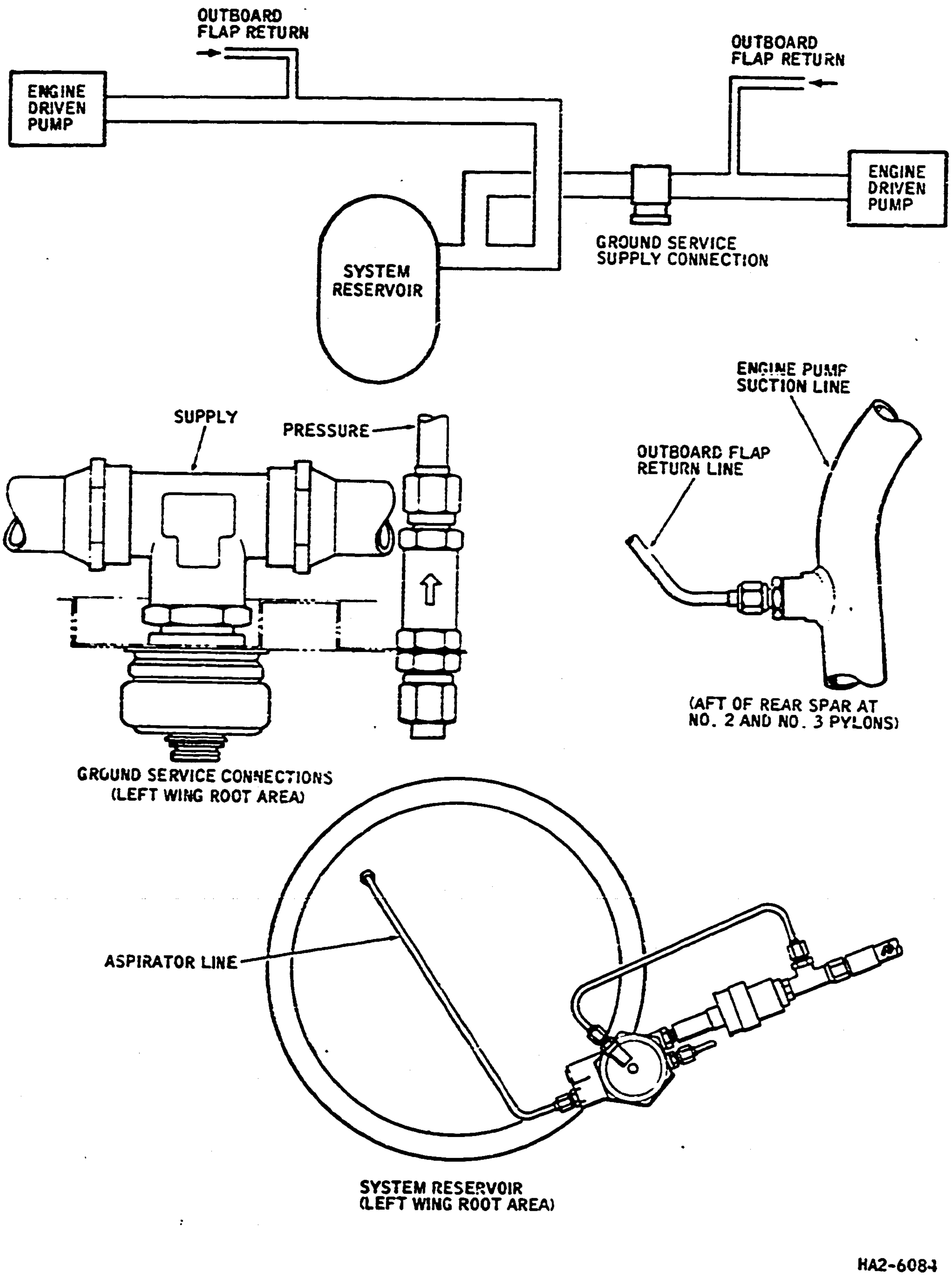
(11) Depressurize test stand.

(12) Close No. 2 and No. 3 engine fire shutoff valve.

(13) Remove test stand pressure hose from No. 2 engine pump supply line, and connect No. 3 engine-driven pump supply line. Open No. 3 engine fire shutoff valve.

(14) Repeat steps (9 through 11).

(15) Close No. 3 engine fire shutoff valve and disconnect test stand from engine-driven pump suction supply hose.



Flushing Procedure Line Connection Locations
Figure 602

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(16) Uncap aspirator line and reservoir aspirator port. Connect aspirator line to reservoir.

(17) Uncap outboard flap return lines and return line ports in pump suction lines and connect flap return lines to suction lines.

(18) Flush main hydraulic reservoir, air chamber, and associated lines as follows:

(a) Disconnect line which runs from air chamber to reservoir air relief valve, located downstream of air bleed valve in left wheel well (see Figure 603).

(b) Connect this line to test stand pressure hose.

(c) At same location disconnect vent line which runs to tee fitting in reservoir filler neck. Cap line.

(d) At filler neck, disconnect both vent lines and connect together with jumper line.

(e) At tee in filler line, disconnect line which runs to high standpipe port at bottom of main reservoir (see Figure 604). Cap tee fitting and connect disconnected line to test stand return hose.

(f) Pressurize test stand to 45 psi maximum at 20 gpm flow.

(g) Flush circuit for five minutes.

(19) Depressurize test stand.

(20) Disconnect test stand pressure hose from overboard line and cap this line. Connect test stand pressure hose to vent line that was capped in step 18, c).

(21) Repeat steps (18, f and g).

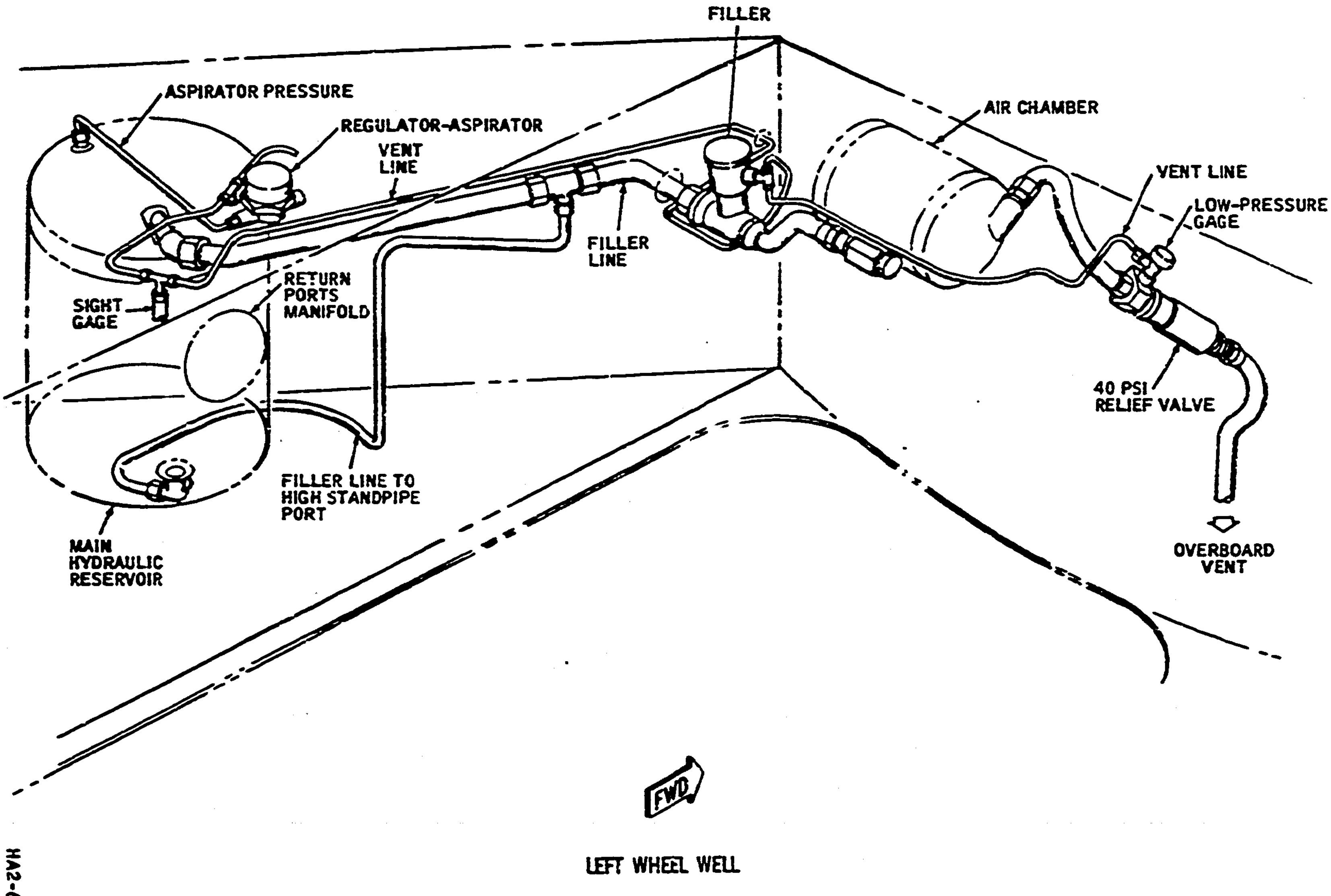
(22) Depressurize test stand, drain and clean out reservoir. Install new reservoir filter element (see 29-10-2).

(23) Restore all lines and units to original configuration.

D. Auxiliary Hydraulic System Alternate Reservoir

NOTE: The auxiliary pump alternate reservoir may be contaminated by the wing flap return line, the auxiliary pump bypass line, or the low-pressure return lines that tie into the wing flap lines.

(1) Disconnect wing flap return line from tee fitting upstream of low pressure return line (see Figure 604). Cap tee.



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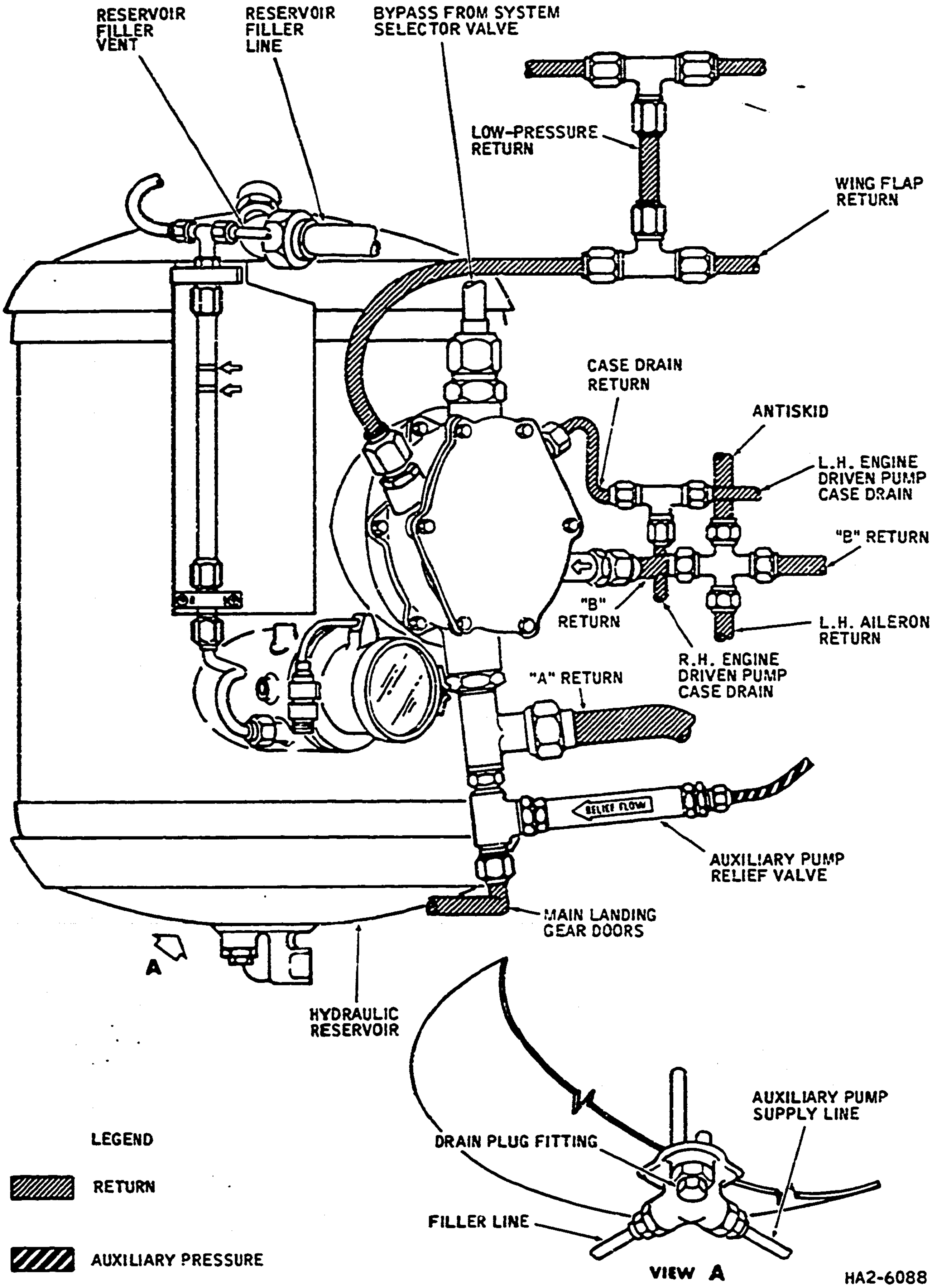
Flushing Procedure Connection Locations
Figure 603



Flushing Procedure Connection Locations
Figure 604

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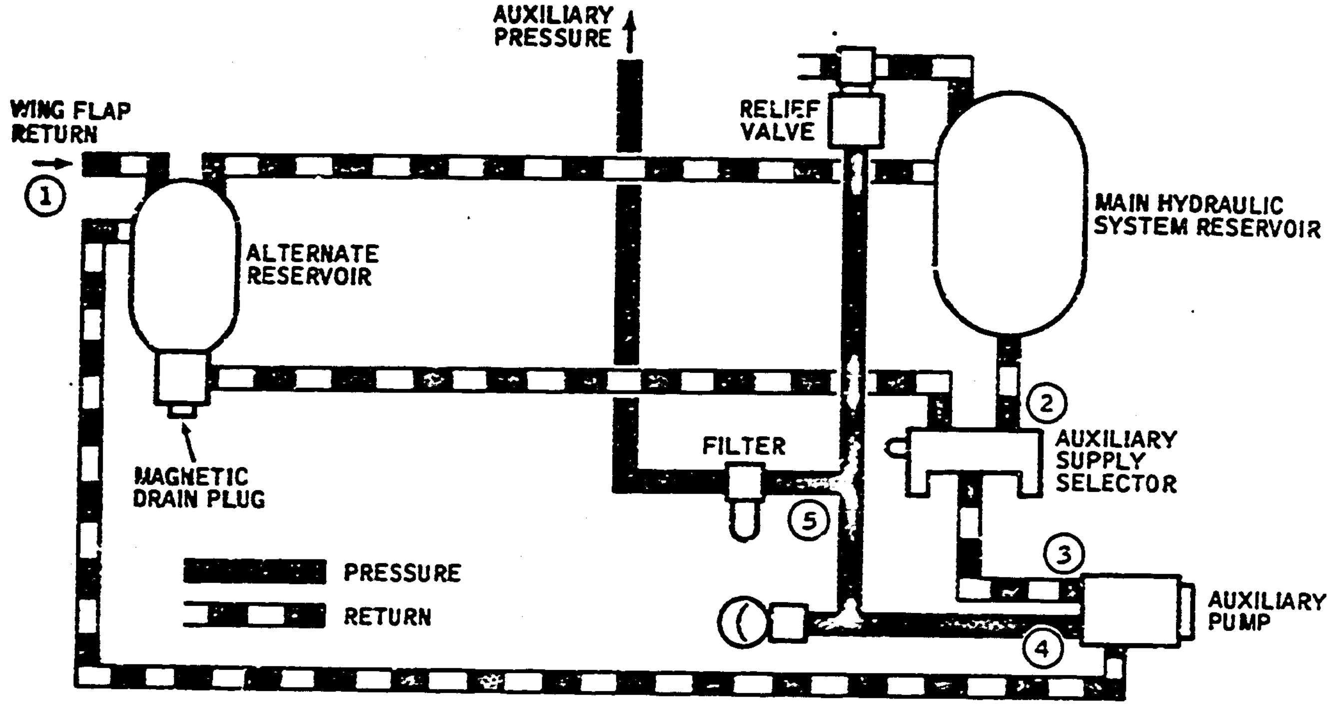
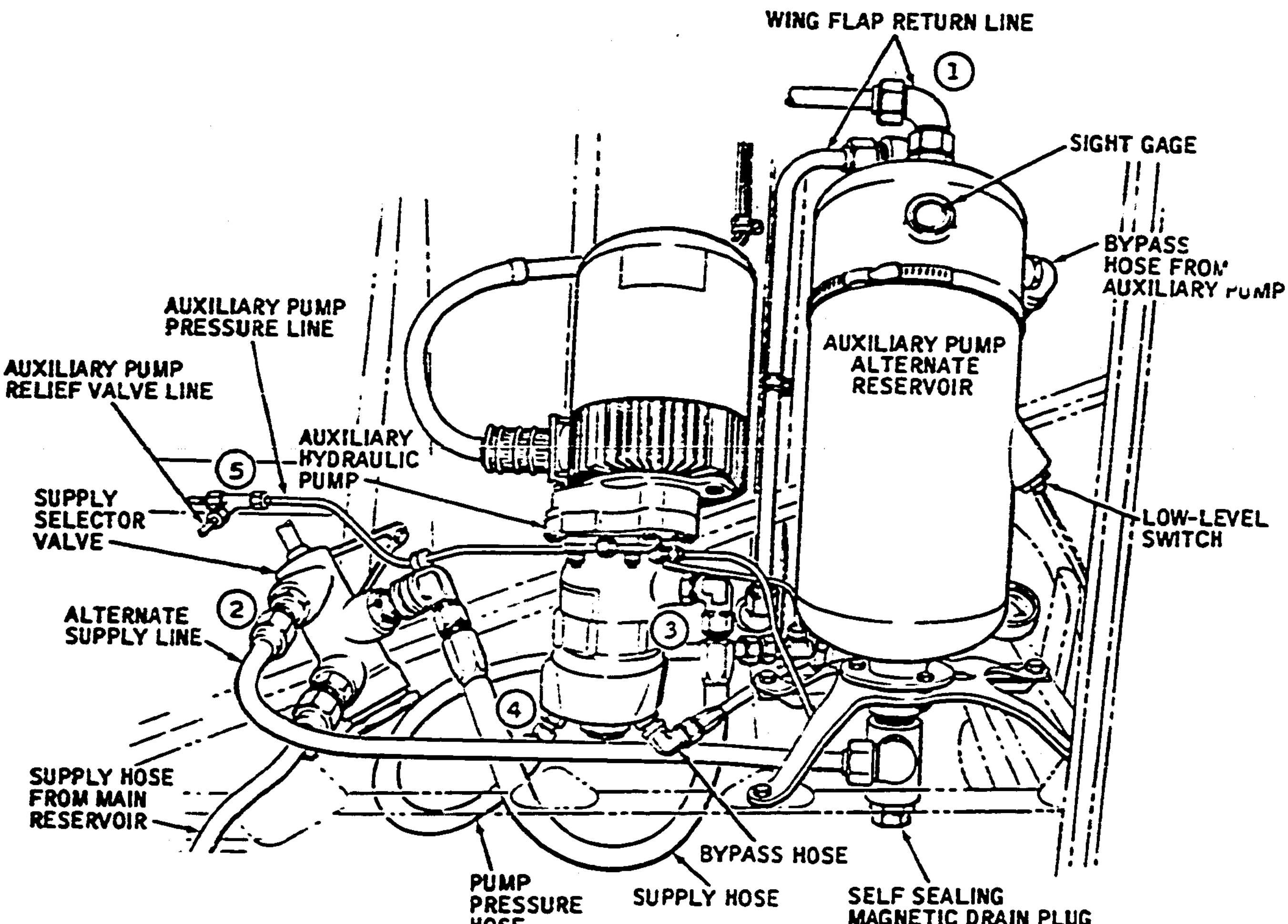


AUXILIARY HYDRAULIC PUMP SYSTEM



Flushing Procedure Line Connection Locations
Figure 605

(2) Connect wing flap return line to test stand pressure hose.

(3) Disconnect alternate supply line from supply selector valve. Connect line to test stand return hose (see Figure 605).

(4) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand, and drain alternate reservoir (see 29-00, Maintenance Practices).

(7) Restore all lines to original configuration.

E. Auxiliary Hydraulic Pump System (See Figures 604 and 605.)

(1) Disconnect auxiliary pump supply line from low standpipe port in bottom of main reservoir. Cap reservoir port, and connect line to test stand pressure hose.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Disconnect auxiliary pump supply and pressure hoses from pump. Connect these two lines together.

(4) Disconnect auxiliary pump pressure line, and relief valve line from tee fitting located adjacent to auxiliary supply selector valve. Connect these lines together.

(5) Disconnect auxiliary pump relief valve inlet line from relief valve, located near A-return line of main reservoir. Connect line to test stand return hose.

(6) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Disconnect test stand pressure hose from auxiliary pump supply hose, and connect to supply selector valve alternate supply port.

(10) Place hydraulic system selector control lever in No. 3 position, and repeat steps (6 through 8).

(11) Remove auxiliary hydraulic pump case drain hose. Clean and/or replace.

(12) Remove auxiliary pump filter element, clean filter bowl. Install clean filter element (see 29-10-5).

(13) Restore all lines and units to original configuration.

MAIN HYDRAULIC POWER SYSTEM (NORMAL AND AUXILIARY) -

INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the main hydraulic power system by flushing the system with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings, as required by the following procedures.

3. Flush Main Hydraulic Power System (See Figure 601.)

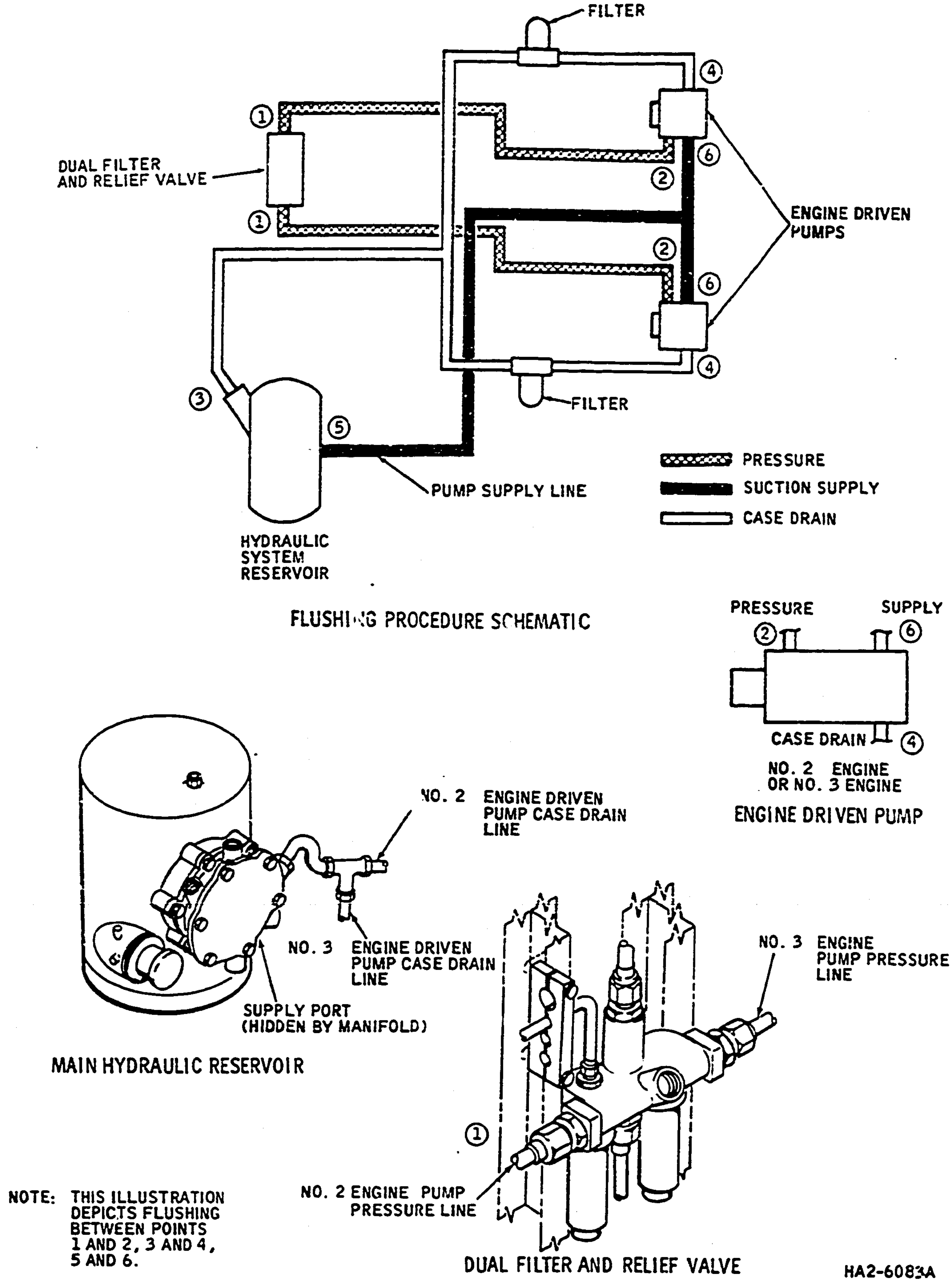
A. Pressure Lines (Engine-Driven Pumps to Dual Filter and Relief Valve)

(1) Disconnect engine-driven hydraulic pump pressure hose from pump in No. 3 pylon.

(2) Disconnect pressure line from right side of dual filter and relief valve, located in left main gear wheel well.

(3) At No. 3 pylon, replace check valve, located between engine pump hose and pressure line, with bulkhead fitting.

(4) Connect engine pump pressure hose to test stand pressure hose, and connect disconnected line at dual filter to test stand return hose.



Flushing Procedure Line Connection Locations
Figure 601

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(5) Pressurize test stand to 200 psi at 5 to 20 gpm fluid flow.

(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Repeat Steps (1 through 7) for pressure line between dual filter and Number 2 engine pump.

(9) Remove dual filter and relief valve filter elements, clear filter bowls, and install clean filter elements (see 29-10-17).

(10) Inspect, clean, and/or replace check valves.

(11) Restore all lines and units to original configuration.

B. Case Drain Lines

(1) Disconnect case drain hose from engine-driven pump in No. 3 pylon. Connect hose to hydraulic test stand pressure hose.

(2) At No. 3 pylon, replace check valve between engine-driven pump hose and case drain line with bulkhead fitting.

(3) At tee fitting, located in B-return line adjacent to reservoir return port (see Figure 601), disconnect No. 2 engine pump case drain line. Cap tee fitting.

(4) Disconnect case drain line from case drain return port in reservoir, and connect this line to test stand return hose. Cap reservoir port.

(5) Disconnect lines from both sides of case drain filter and check valve, and jumper these return lines.

(6) Pressurize test stand to 200 psi maximum, at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Repeat Steps (1 and 2) for engine pump in No. 2 pylon.

(10) Connect No. 2 engine pump case drain line, which was disconnected in Step (3), to hydraulic test stand return hose.

(11) Repeat Step (5) for No. 2 engine case drain filter and check valve.

(12) Repeat Steps (6 through 8) for No. 2 engine pump case drain lines.

(13) Clean filter bowls and replace filter elements in case drain filters, located on rear spar (see 29-10-15).

(14) Inspect, clean, and/or replace check valves.

(15) Restore all lines and units to original configuration.

C. Reservoir and Suction System

(1) Do not disconnect or remove large reducer tee fitting and connecting supply lines from reservoir.

(2) Connect hydraulic test stand return hose to airplane ground service supply connection (see Figure 602).

(3) Drain reservoir, remove reservoir filter element (see 29-10-2). Clean out reservoir.

(4) Temporarily install reservoir filter cover plate. Disconnect and cap all return ports.

(5) Disconnect aspirator line at reservoir end. Cap reservoir end and cap reservoir port.

(6) Disconnect suction hose from No. 2 engine-driven pump and connect test stand pressure hose to suction hose.

(7) Open fire shutoff valve on No. 2 engine.

(8) Disconnect and cap outboard flap return lines and port connectors where they connect to suction lines on rear spar aft of No. 2 and No. 3 pylons. (see Figure 602).

(9) Pressurize test stand to 45 psi at 20 gpm flow.

(10) Flush from engine pump suction hose to reservoir for five minutes.

CAUTION: WHEN FLUSHING THE SUPPLY LINES, MONITOR THE RESERVOIR FLUID LEVEL AND THE AIR PRESSURE GAGE ON TOP OF THE RESERVOIR AIR BLEED VALVE. THE FLUID LEVEL MUST BE VISIBLE IN THE SIGHT GAGE, AND THE PRESSURE MUST NOT EXCEED 45 PSI TO PREVENT DAMAGE TO THE RESERVOIR.

(11) Depressurize test stand.

(12) Close No. 2 and No. 3 engine fire shutoff valve.

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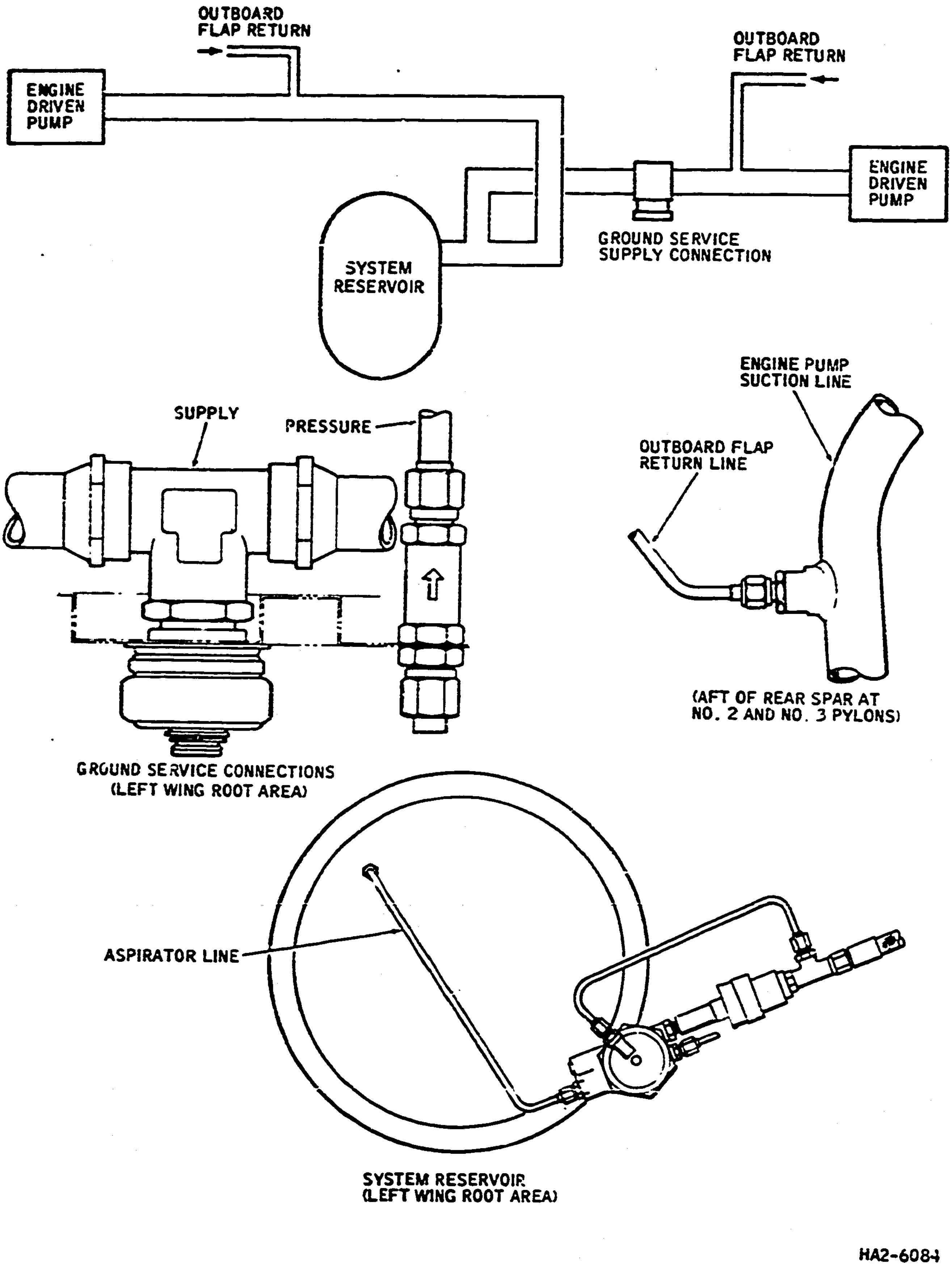

Flushing Procedure Line Connection Locations
Figure 602

(13) Remove test stand pressure hose from No. 2 engine pump supply line, and connect number 3 engine-driven pump supply line. Open No. 3 engine fire shutoff valve.

(14) Repeat Steps (9 through 11).

(15) Close No. 3 engine fire shutoff valve and disconnect test stand from engine-driven pump suction supply hose.

(16) Uncap aspirator line and reservoir aspirator port. Connect aspirator line to reservoir.

(17) Uncap outboard flap return lines and return line ports in pump suction lines and connect flap return lines to suction lines.

(18) Flush main hydraulic reservoir, air chamber, and associated lines as follows:

(a) Disconnect line which runs from air chamber to reservoir air relief valve, located downstream of air bleed valve in left wheel well (see Figure 603).

(b) Connect this line to test stand pressure hose.

(c) At same location, disconnect vent line which runs to tee fitting in reservoir filler neck. Cap line.

(d) At filler neck, disconnect both vent lines and connect together with jumper line.

(e) At tee in filler line, disconnect line which runs to high standpipe port at bottom of main reservoir (see Figure 604). Cap tee fitting and connect disconnected line to test stand return hose.

(f) Pressurize test stand to 45 psi maximum at 20 gpm flow.

(g) Flush circuit for five minutes.

(19) Depressurize test stand.

(20) Disconnect test stand pressure hose from overboard line and cap this line. Connect test stand pressure hose to vent line that was capped in Step (18, c).

(21) Repeat Steps (18, f and g).

(22) Depressurize test stand, drain and clean out reservoir. Install new reservoir filter element (see 29-10-2).

(23) Restore all lines and units to original configuration.

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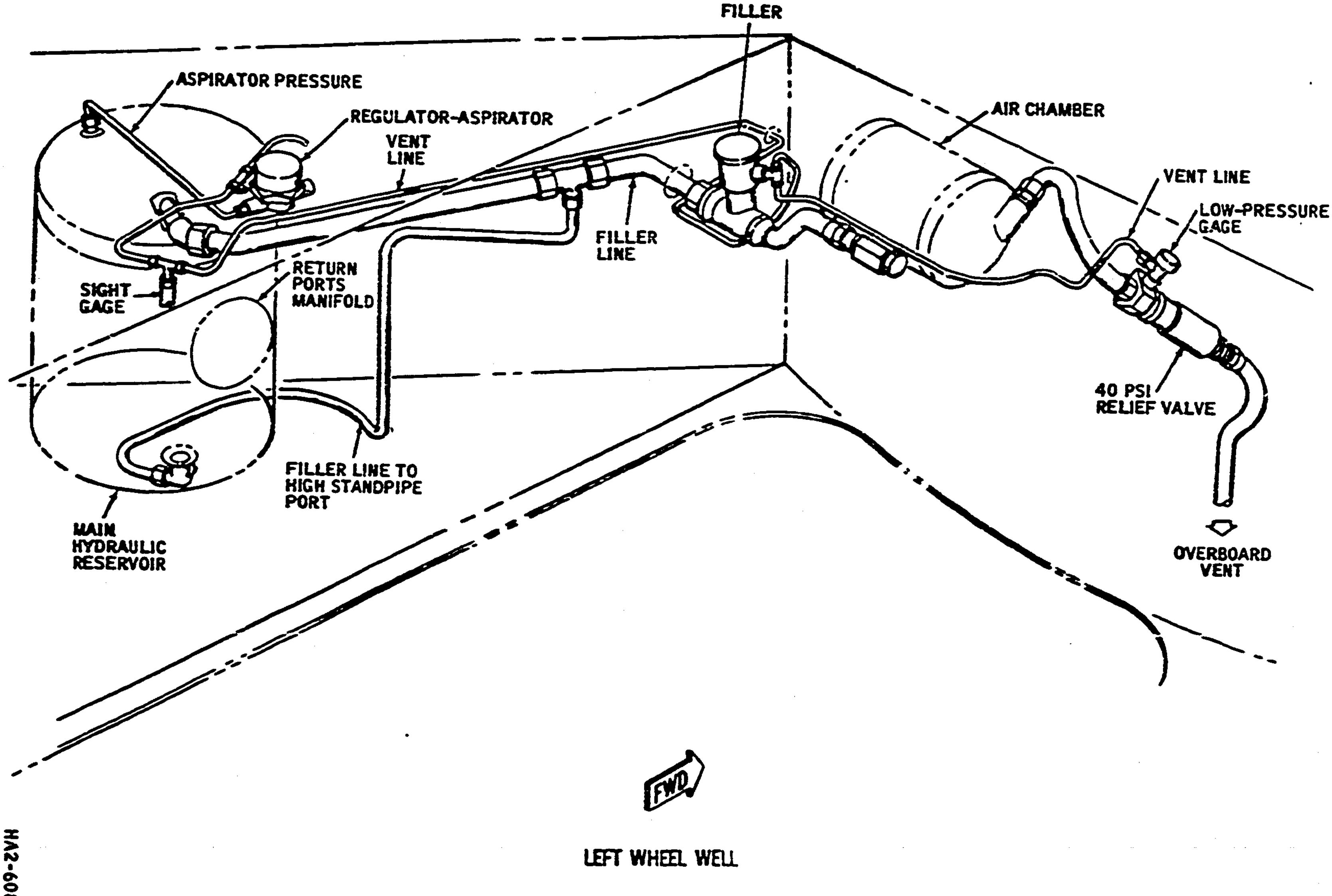
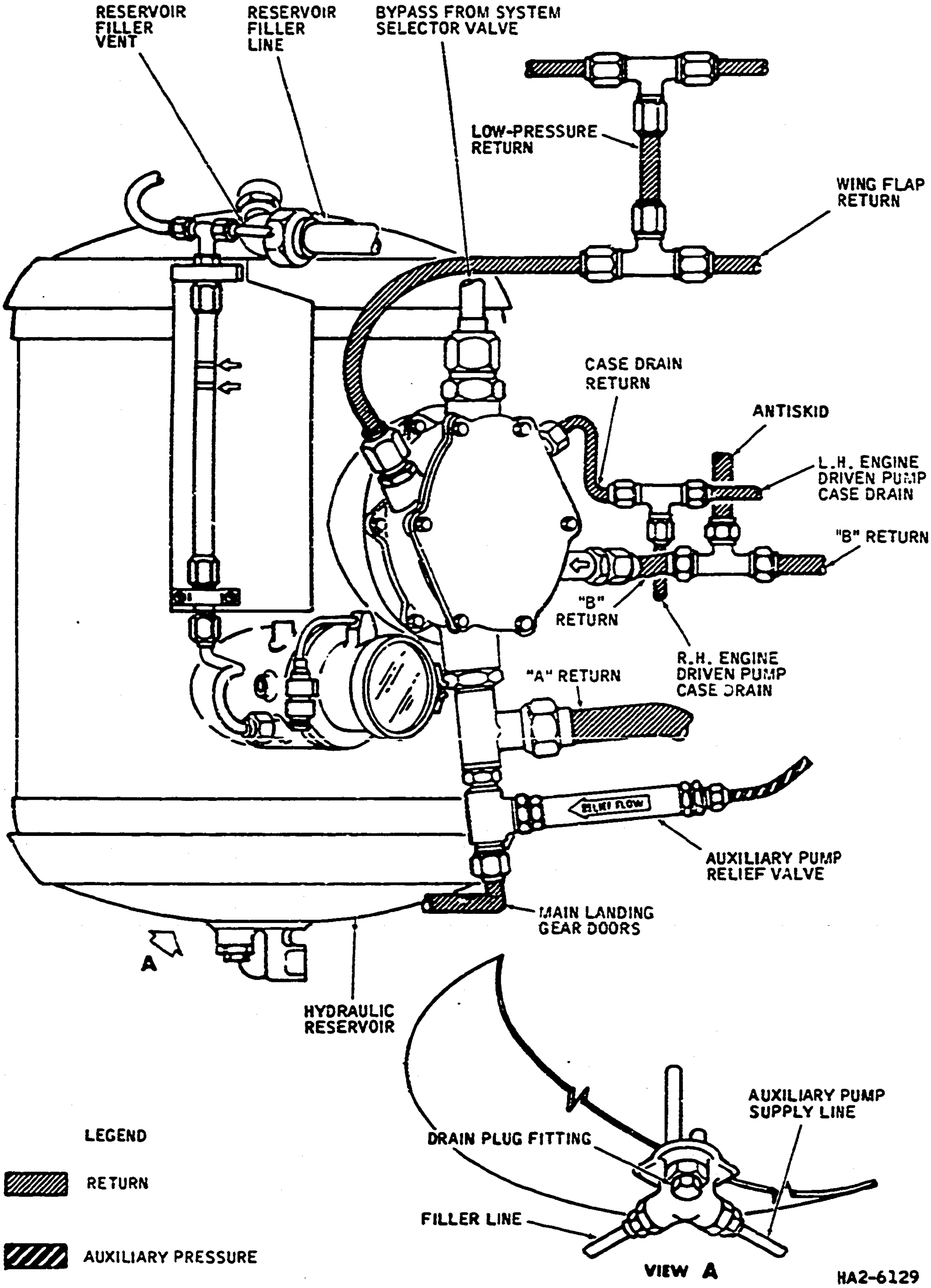


Flushing Procedure Connection Locations
Figure 603



Flushing Procedure Connection Locations
Figure 604

D. Auxiliary Hydraulic System Alternate Reservoir

NOTE: The auxiliary pump alternate reservoir may be contaminated by the wing flap return line, the auxiliary pump case drain line, or the low-pressure return lines that tie into the wing flap lines.

(1) Disconnect wing flap return line from tee fitting upstream of low pressure return line (see Figure 604). Cap tee.

(2) Connect wing flap return line to test stand pressure hose.

(3) Disconnect alternate supply line from supply selector valve. Connect line to test stand return hose (see Figure 605).

(4) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand, and drain alternate reservoir (see 29-00, Maintenance Practices).

(7) Restore all lines to original configuration.

E. Auxiliary Hydraulic Pump System (See Figures 604 and 605.)

(1) Disconnect auxiliary pump supply line from low standpipe port in bottom of main reservoir. Cap reservoir port, and connect line to test stand pressure hose.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Disconnect auxiliary pump supply and pressure hoses from pump. Connect these two lines together.

(4) Disconnect auxiliary pump pressure line, and relief valve line from tee fitting located adjacent to auxiliary supply selector valve. Connect these lines together.

(5) Disconnect auxiliary pump relief valve inlet line from relief valve, located near A-return line of main reservoir. Connect line to test stand return hose.

(6) Pressurize test stand to 100 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

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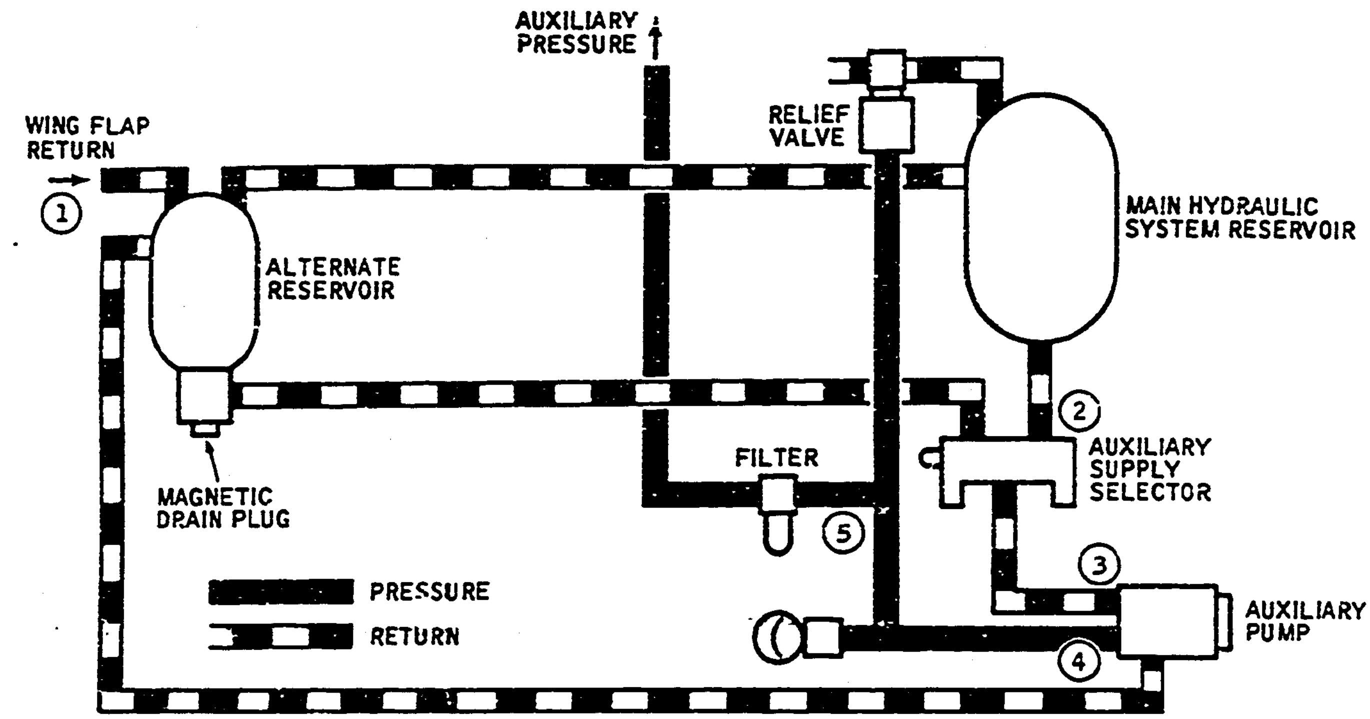
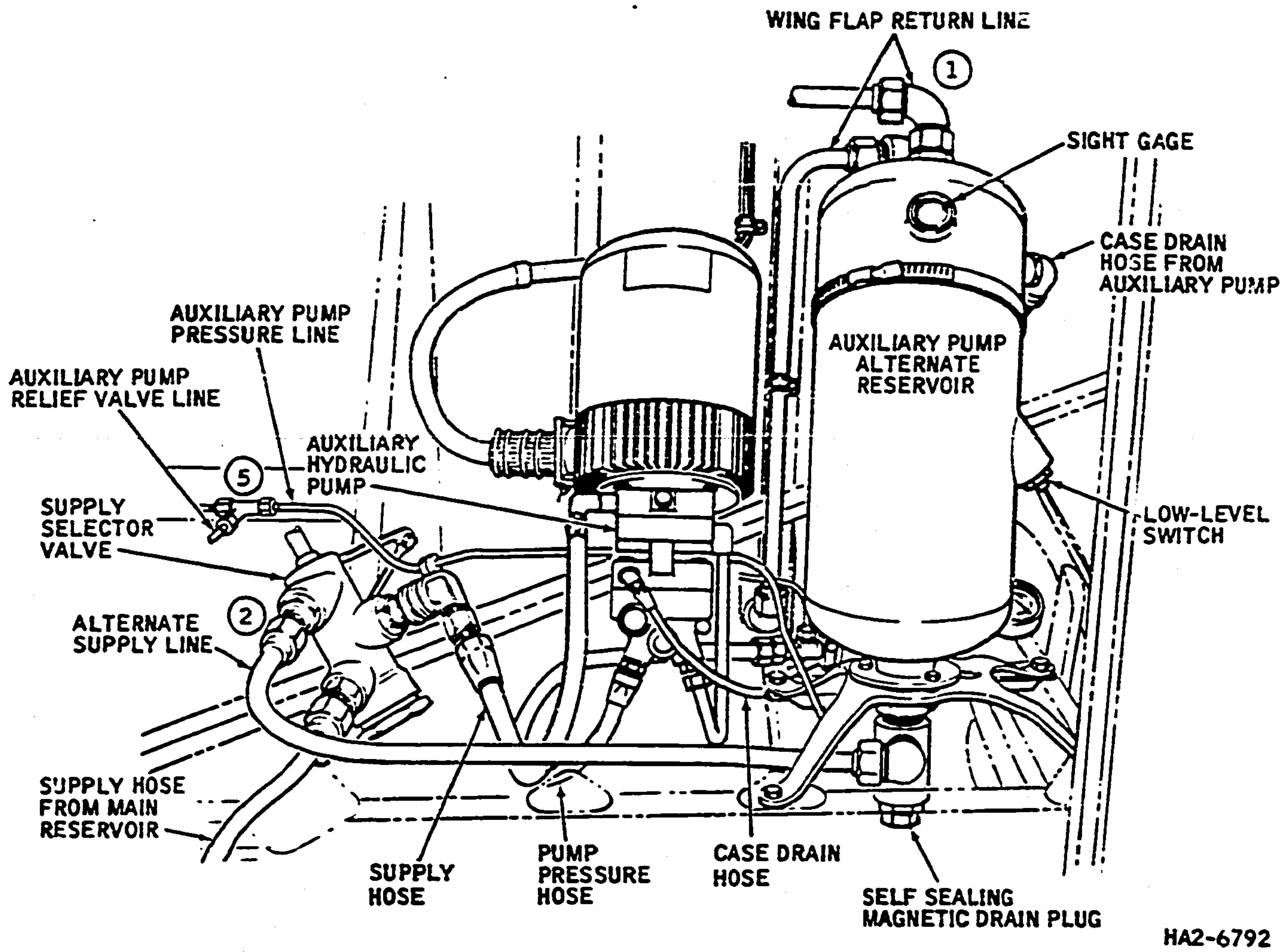


AUXILIARY HYDRAULIC PUMP SYSTEM



Flushing Procedure Line Connection Locations
Figure 605

(9) Disconnect test stand pressure hose from auxiliary pump supply hose, and connect to supply selector valve alternate supply port.

(10) Place hydraulic system selector control lever in No. 3 position, and repeat Steps (6 through 8).

(11) Remove auxiliary hydraulic pump case drain hose. Clean, and/or replace.

(12) Remove suxiliary pump filter element, clean filter bowl. Install clean filter element (see 29-10-5).

(13) Restore all lines and units to original configuration.

MAIN HYDRAULIC POWER SYSTEM (BEYOND DUAL FILTER AND RELIEF VALVE) - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the main hydraulic power system by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Main Hydraulic Power System (Beyond Dual Filter and Relief Valve)

A. Regulator-Aspirator Pressure Line (See Figure 601.)

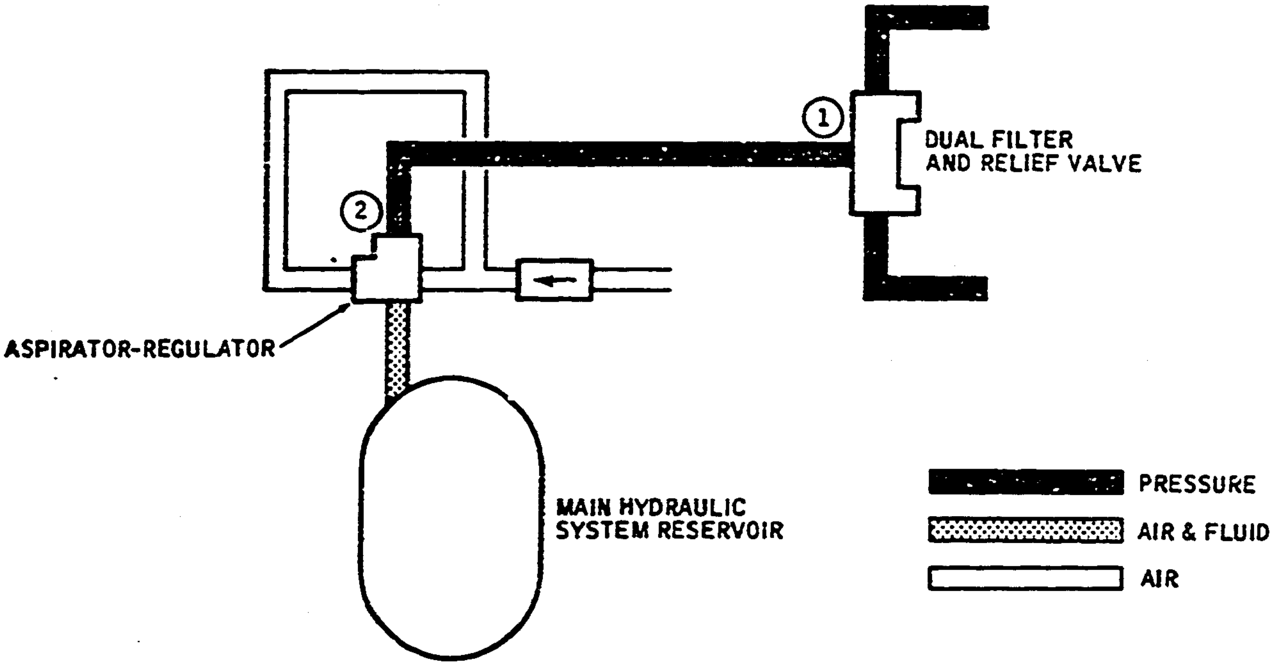
(1) Remove 1/4-inch regulator-aspirator pressure line, located between aspirator and dual filter and relief valve.

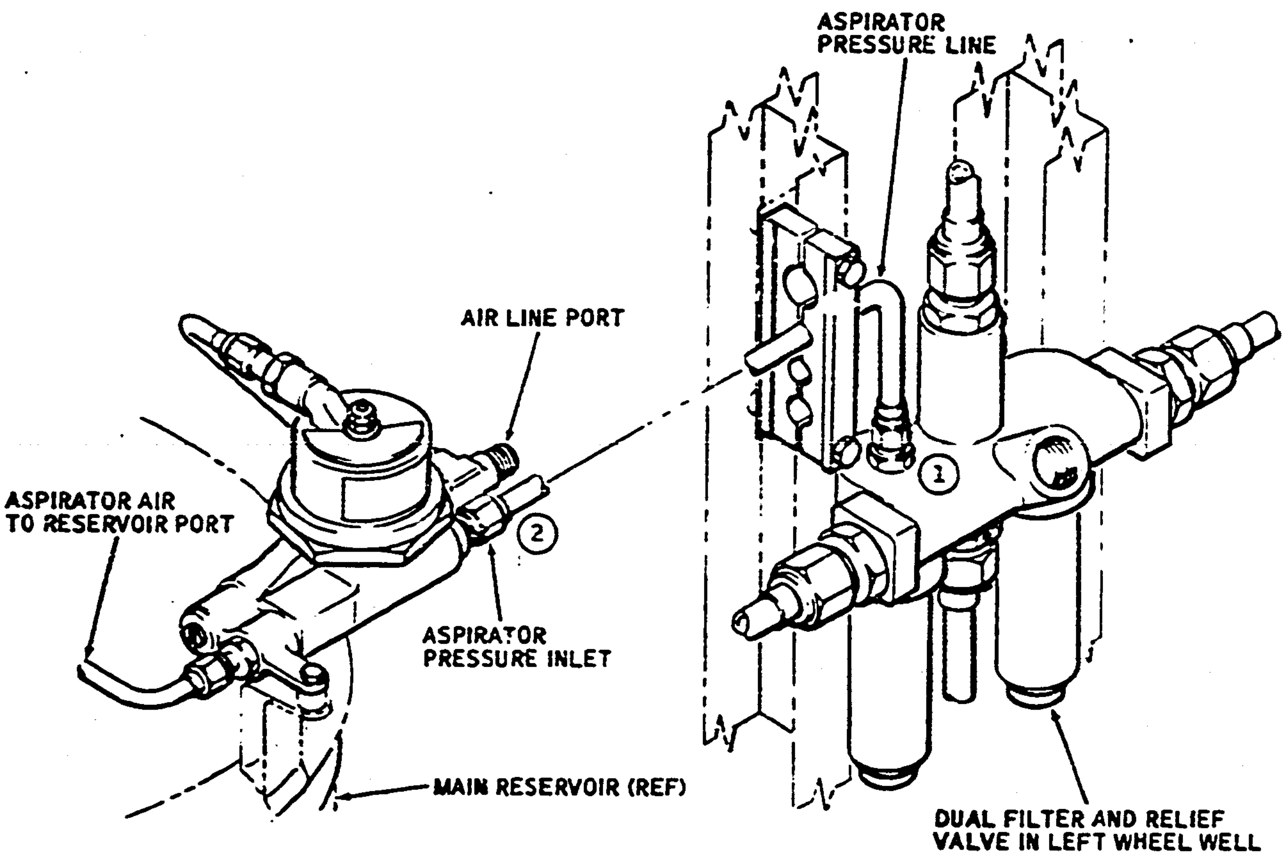
(2) Connect test stand pressure hose to one end of line, and connect test stand return hose to other end.

(3) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(4) Flush line for five minutes.

(5) Depressurize test stand and remove hoses.





HA2-6089

Flushing Procedure Line Connection Locations
Figure 601

(6) Inspect regulator-aspirator inlet filter for contamination. Replace or clean filter as necessary.

(7) Connect aspirator line to aspirator and to dual filter and relief valve.

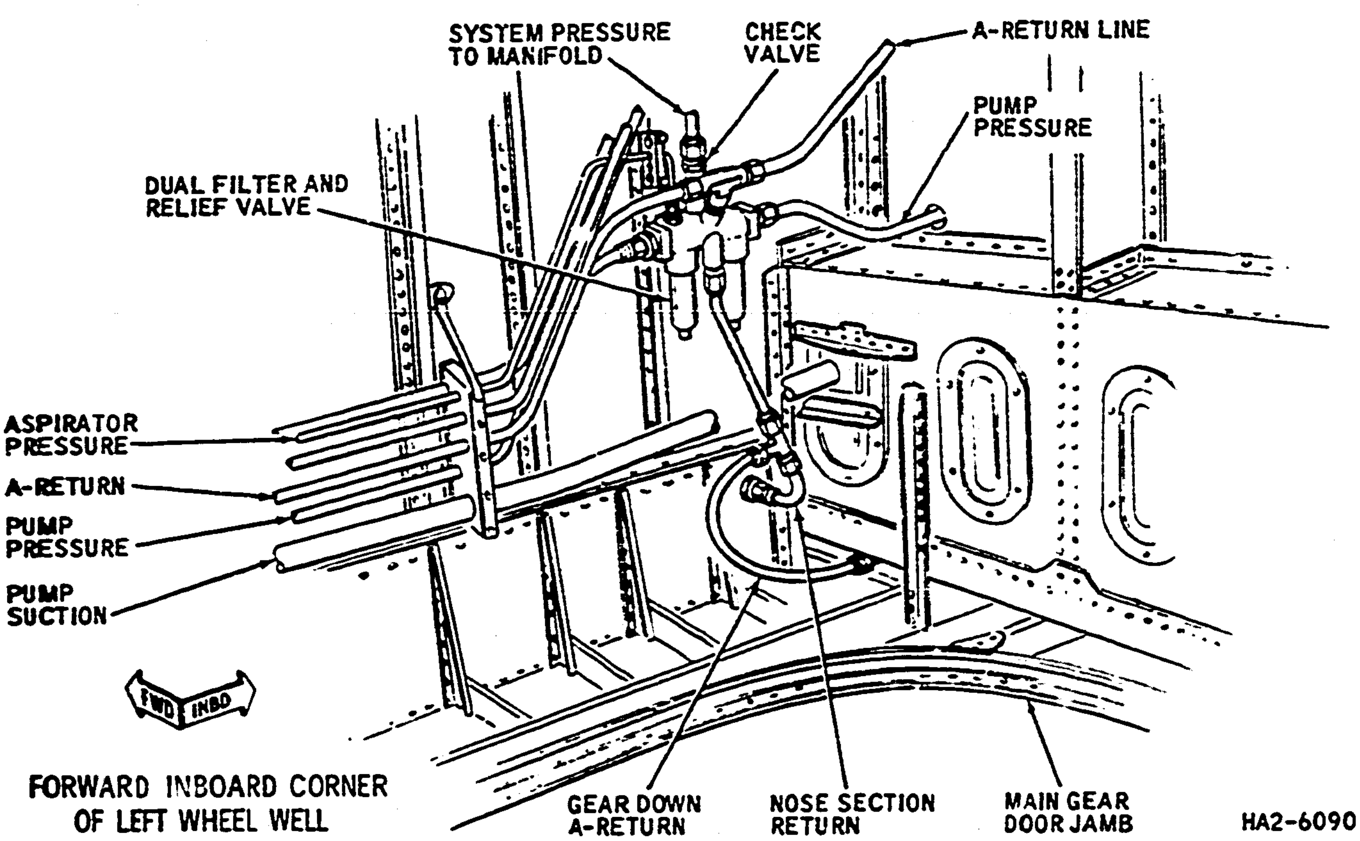
B. Empennage Pressure and Return Lines (See Figures 602 Through 604.)

NOTE: This procedure covers the lines from the dual filter and relief valve (outlet side) to the rudder and horizontal stabilizer filter, located in the pressure line in the empennage, and the B-return and low-pressure return lines from the empennage bulkhead back to the left wheel well.

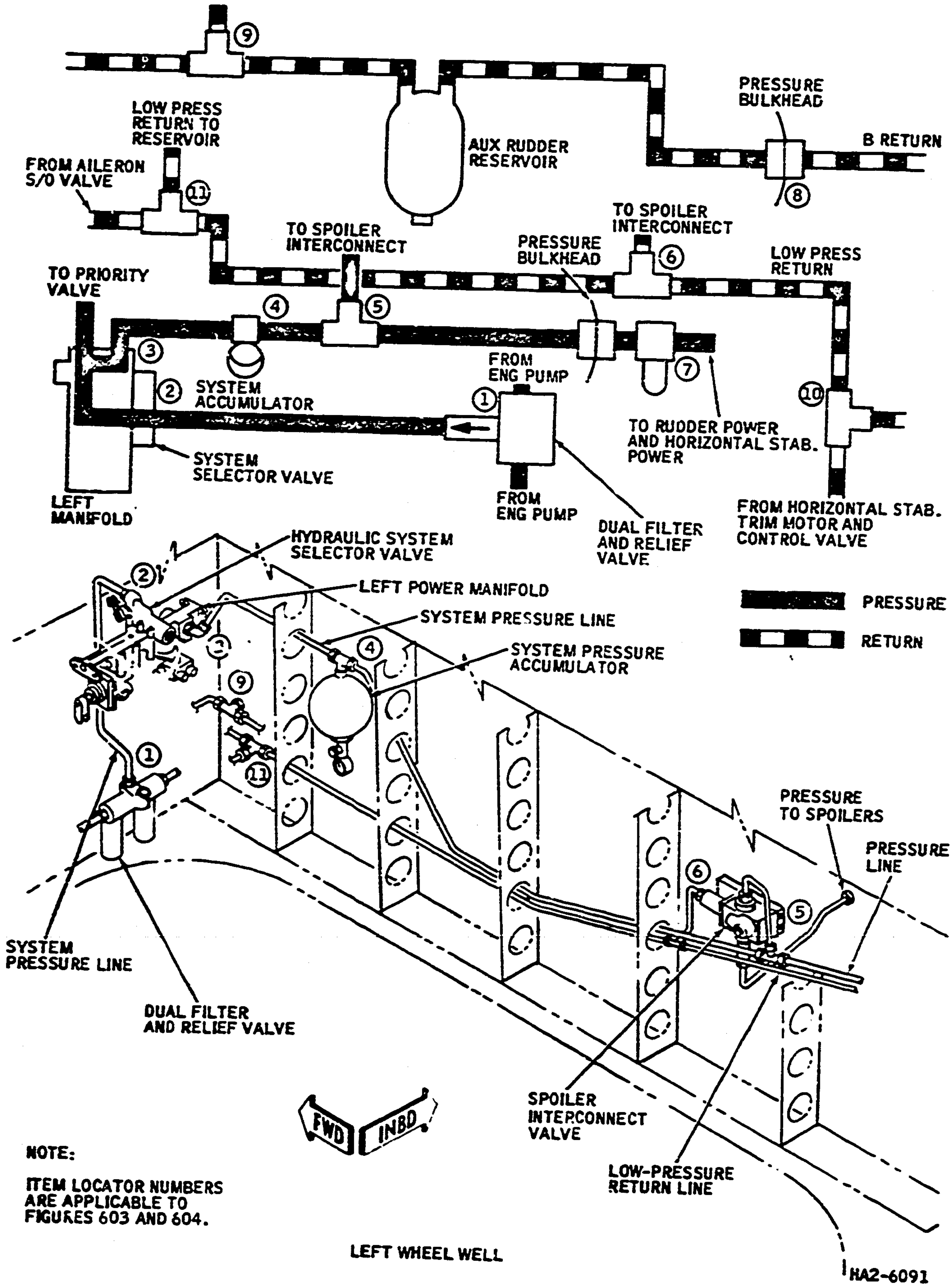
(1) Disconnect pressure line from check valve, located on top side of dual filter and relief valve. Connect this line to test stand pressure hose.

(2) Inspect, clean, and/or replace check valve.

(3) Place system selector valve in general system (normal) position.



Flushing Procedure Line Connection Locations
Figure 602



NOTE:

ITEM LOCATOR NUMBERS ARE APPLICABLE TO FIGURES 603 AND 604.

Flushing Procedure Line Connection Locations
Figure 603

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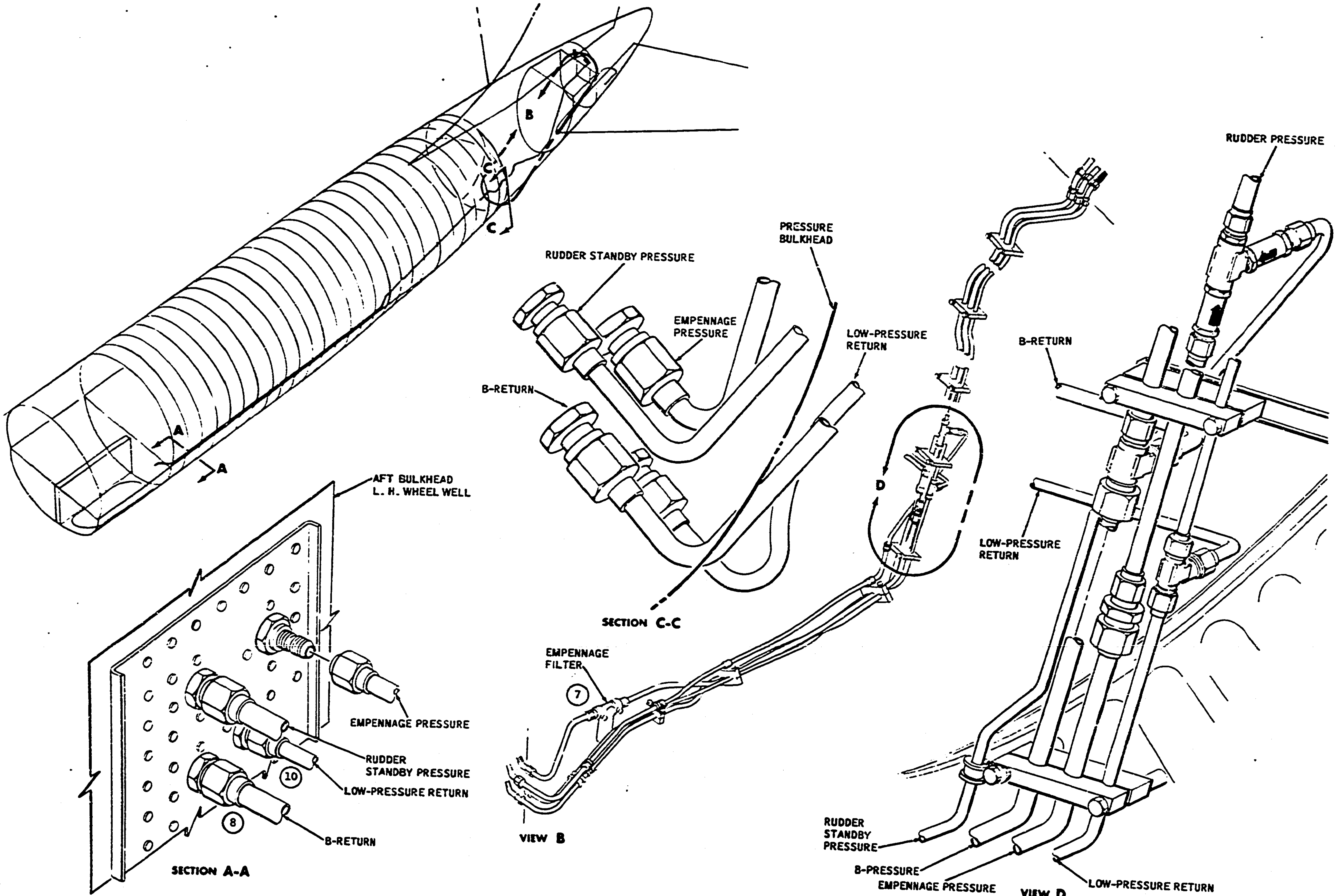


Flushing Procedure Line Connection Locations
Figure 604

(4) Disconnect lines which run from tees in low-pressure return line and empennage pressure line to spoiler interconnect valve. Cap tees. Spoiler interconnect valve is located on inboard side of left wheel well.

(5) In empennage, disconnect pressure line at empennage filter. Install jumper between this line and B-return line at pressure bulkhead.

(6) Disconnect empennage B-return line at tee fitting in B-return line, located below left power manifold. Connect aft line to test stand return hose. Cap tee fitting.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) In empennage, disconnect jumper line from B-return line, and connect to low-pressure return line.

(11) Disconnect 1/4-inch low-pressure line (empennage drain) from tee fitting in low-pressure return line (case drain), located to left of centerline of airplane and aft of rear spar.

(12) Disconnect test stand return hose from B-return hose, and connect it to low-pressure return line located inboard of dual filter and relief valve.

(13) Repeat Steps (8 through 10).

(14) Clean or replace empennage filter element and bowl.

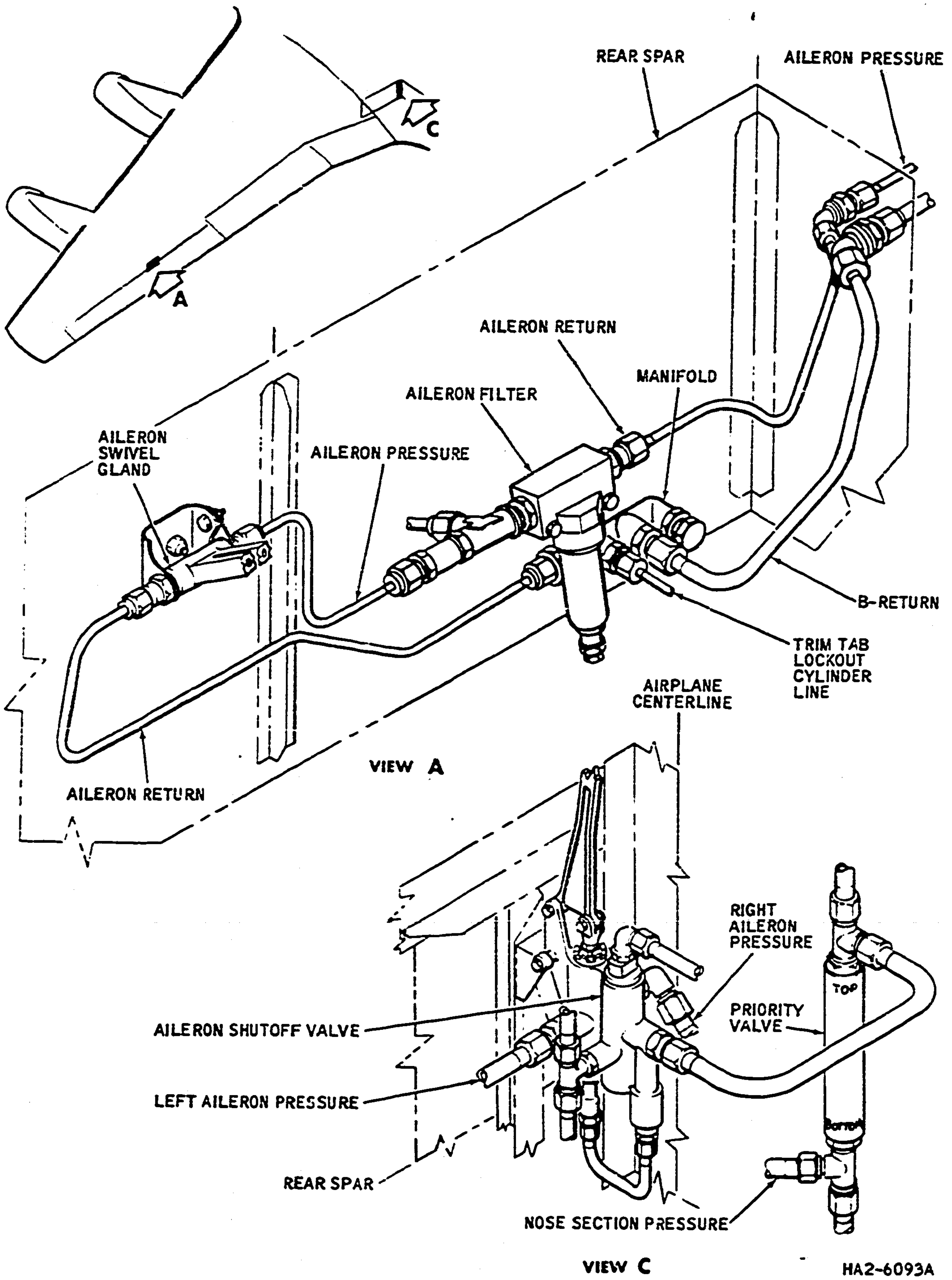
(15) Inspect, clean, and/or replace hydraulic system accumulator.

(16) Restore all lines and units to original configuration.

<u>NOTE:</u> For continuation of flushing rudder and horizontal stabilizer systems, refer to 29-05.

C. Aileron Pressure and Return Lines (See Figure 605.)

(1) Disconnect aileron pressure line at inboard port of left aileron filter, and disconnect aileron B-return line from aileron swivel gland. Connect these two lines together with jumper.



Flushing Procedure Line Connection Locations
Figure 605

(2) Disconnect left aileron pressure line at aileron shutoff valve, located in left wheel well. Connect this line to test stand pressure hose.

(3) Disconnect aileron B-return line from cross fitting at B-return port of reservoir. Connect this line to test stand return hose.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Disconnect pressure line at inboard port of right aileron filter, and disconnect aileron A-return line from aileron swivel gland. Connect these two lines together.

(8) Disconnect right aileron pressure line at aileron shutoff valve, located in left wheel well. Connect line to test stand pressure hose.

(9) Disconnect aileron A-return line from tee at the bottom of right power manifold, located in right wheel well. Connect line to test stand return hose.

(10) Repeat Steps (5 through 7) for these lines.

(11) Remove, inspect, clean, and/or replace priority valve and fittings, located on bottom of the left power manifold.

(12) Restore all lines and units to original configuration.

(13) Clean and/or replace aileron filter elements.

NOTE: For continuation of flushing aileron system components, refer to 29-05.

D. Nose System Pressure and Return Lines (See Figure 606.)

(1) In nosewheel well, disconnect 1/4-inch return line which runs from nose gear control valve to bulkhead tee fitting in A-return line, at tee. Cap tee.

(2) Disconnect pressure line leading into nose gear control valve at valve. In this same line, replace check valve with jumper line.

(3) Disconnect pressure line which runs to tee in pressure accumulator, from pressure bulkhead tee at rear of wheel well.

(4) Connect two open lines from Step (2 and 3) with jumper.

(5) Disconnect at tee, pressure line which runs from reserve pressure accumulators to tee near centerline of airplane. Cap tee.

(6) Disconnect pressure line leading into reserve accumulator shutoff valve.

(7) Disconnect return line from tee in steering relief valve. Connect this line to pressure line at shutoff valve with jumper line.

(8) On freighter type airplanes, disconnect cargo door pressure line at tee fitting in nose system pressure line. Cap tee and cargo door pressure line.

NOTE: The cargo door pressure line tee fitting is located in the forward left side of the forward baggage compartment.

(9) In left main gear wheel well, disconnect nose system pressure line from side port of tee in priority valve. Connect line to test stand pressure hose.

(10) Disconnect nose system A-return line from bottom of dual filter and relief valve. Connect line to test stand return hose.

(11) Disconnect main gear control valve A-return line from tee in nose gear A-return line. Cap tee.

(12) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(13) Flush circuit for five minutes.

(14) Depressurize test stand.

(15) Remove, inspect, clean, and/or replace miniature check valve, located in nose system return port of dual filter and relief valve.

(16) Repeat Step (15), inspection etc., for following items:

(a) Two check valves jumpered in nosewheel well.

(b) Two reserve pressure accumulators and attaching lines

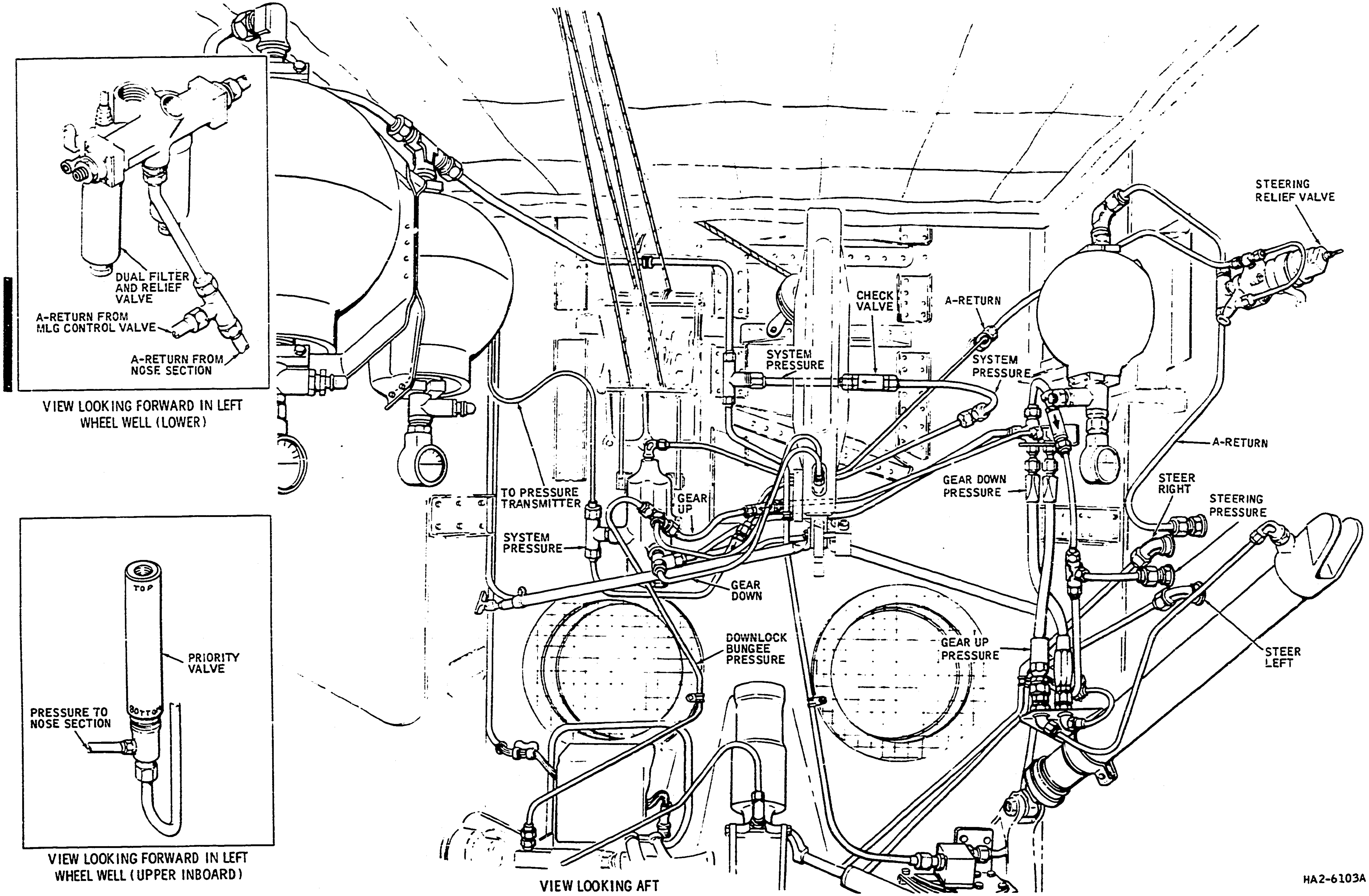
(c) System pressure transmitter and attaching lines.

(17) Restore all lines and units to original configuration.

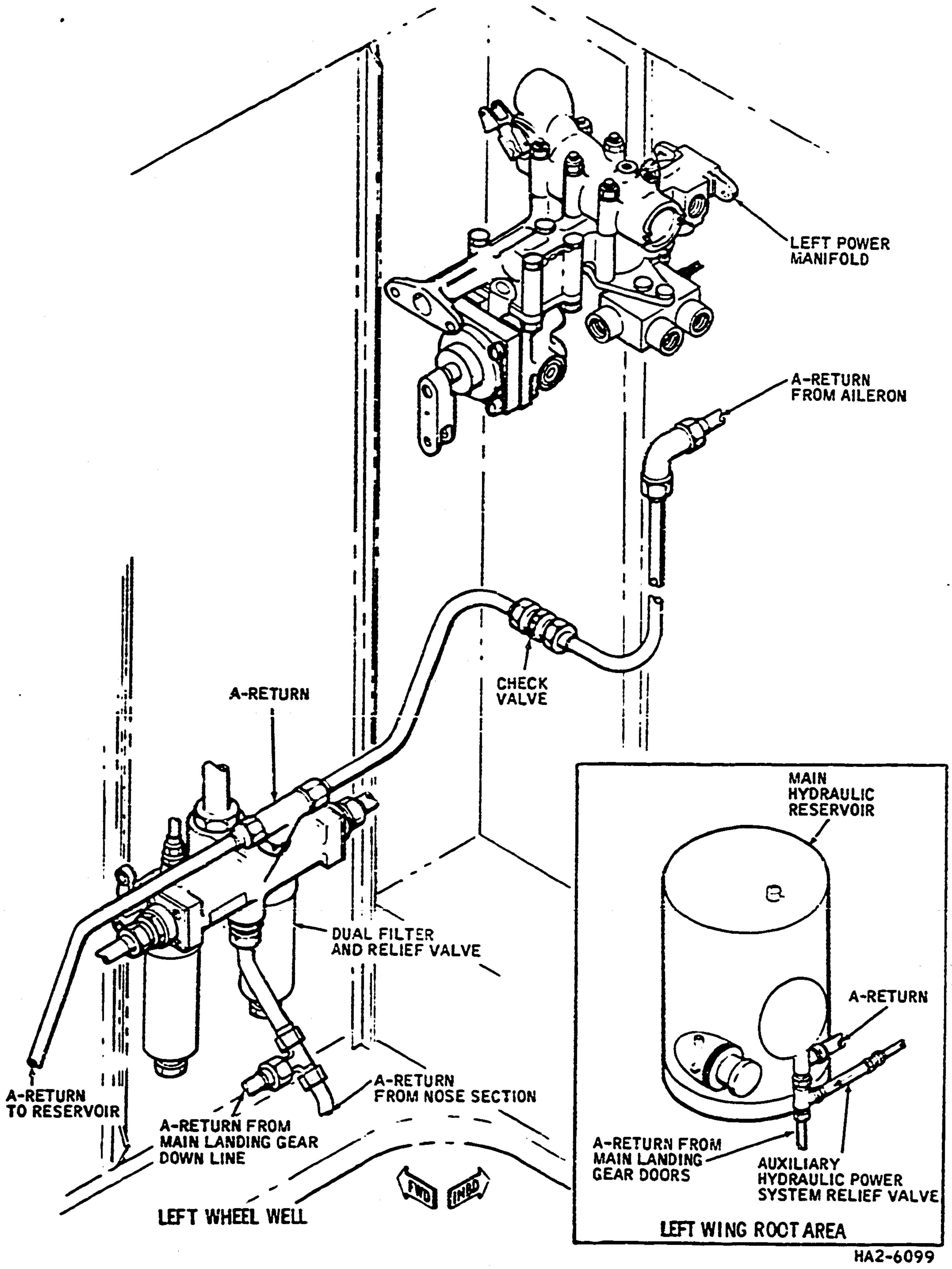
NOTE: For continuation of flushing of nose gear system, refer to 29-04.

E. Flush A-Return Line (See Figure 607.)

(1) Disconnect aileron A-return line from bulkhead elbow in A-return line, located below left power manifold. Cap elbow.



Flushing Procedure Line Connection Locations
Figure 606



Flushing Procedure Line Connection Locations
Figure 607

(2) Connect line to test stand pressure hose.

(3) Place jumper around miniature check valve, located in A-return line under left power manifold.

(4) Disconnect A-return lines from tee in dual filter and relief valve. Install jumper between these lines.

(5) Disconnect A-return line from reservoir fittings. Connect line to test stand return hose.

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Inspect, clean, and/or replace miniature check valve which was removed in Step (3).

(10) Restore all lines and units to original configuration.

F. Flush B-Return Line (See Figure 608.)

(1) Disconnect B-return line from miniature check valve installed in right power manifold. Connect this line to test stand pressure hose.

(2) Disconnect empennage return line from tee in B-return line. Cap tee.

(3) Disconnect left antiskid return line, and left aileron return line from B-return cross fitting located adjacent to main reservoir. Cap two openings.

(4) Disconnect B-return line from check valve in reservoir B port. Connect line to test stand return hose.

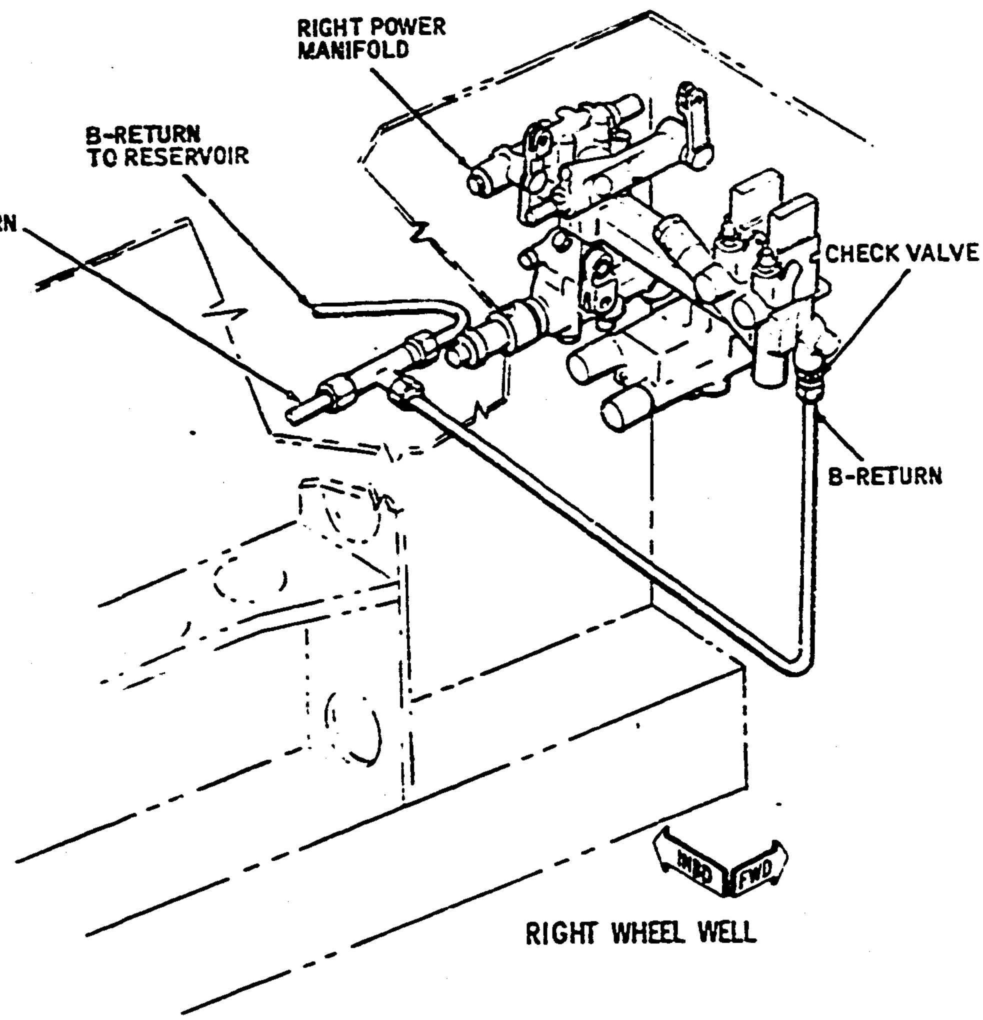
(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for five minutes.

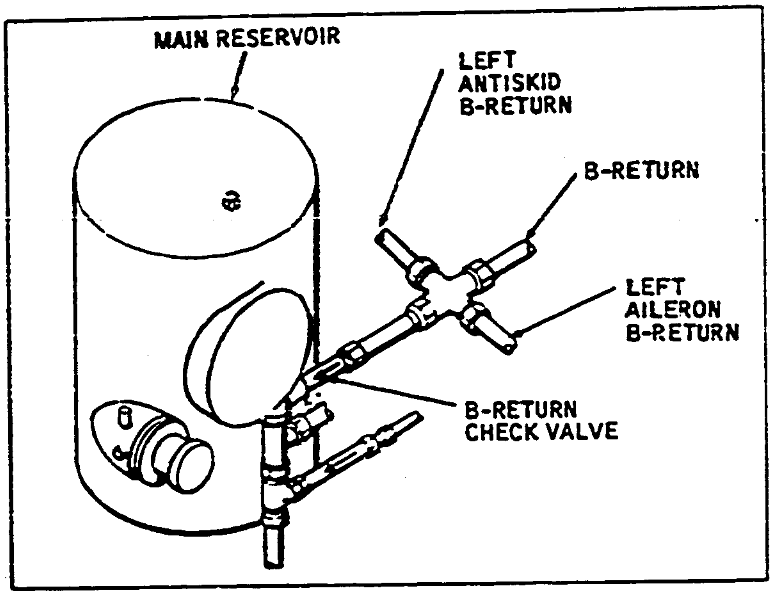
(7) Depressurize test stand.

(8) Remove check valve from reservoir B port, and miniature check valve (Step 1.). Inspect, clean, and/or replace check valves.

(9) Restore all lines and units to original configuration.



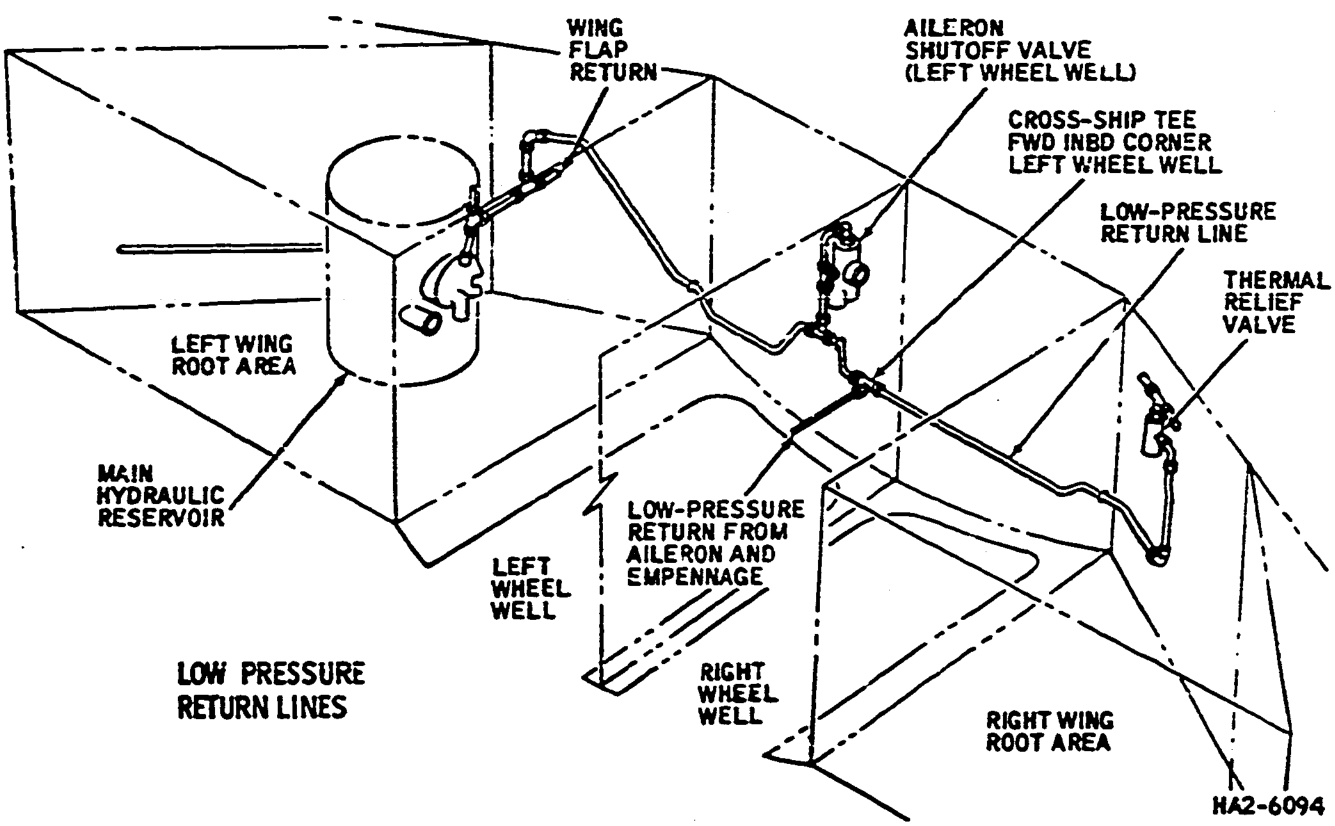
RIGHT WHEEL WELL



LEFT WING ROOT AREA

HA2-6100

Flushing Procedure Line Connection Locations
Figure 608



Flushing Procedure Line Connection Locations
Figure 609

G. Power Manifolds

(1) If contamination downstream of the dual filter and relief valve is general, the right and left power manifolds with attaching valves must be removed, inspected, cleaned, and/or replaced.

H. Flush Low-Pressure Return Lines (See Figure 609.)

(1) In right wing root area, disconnect low-pressure return line from wing flap thermal relief valve. Connect this line to test stand pressure hose. Thermal relief valve is located on the rear spar.

(2) In left wheel well, below dual filter and relief valve, disconnect low-pressure return line from top of tee which connects aileron valve drain and empennage drain returns to cross-ship low-pressure return. Cap tee.

(3) Disconnect low-pressure return line from tee fitting that joins wing flap return at main reservoir. Cap tee, and connect line to test stand return hose.

(4) Pressurize test stand to 200 psi at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Remove line from tee in aileron shutoff valve to tee fitting in low-pressure return line, in left wheel well. Flush line.

(8) Remove, clean and/or replace aileron shutoff valve and thermal relief valve.

(9) Restore all lines and units to original configuration.

MAIN HYDRAULIC POWER SYSTEM (BEYOND DUAL FILTER AND RELIEF VALVE) - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the main hydraulic power system by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Main Hydraulic Power System (Beyond Dual Filter and Relief Valve)

A. Regulator-Aspirator Pressure Line (See Figure 601.)

(1) Remove 1/4-inch regulator-aspirator pressure line, located between aspirator and dual filter and relief valve.

(2) Connect test stand pressure hose to one end of line, and connect test stand return hose to other end.

(3) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(4) Flush line for five minutes.

(5) Depressurize test stand and remove hoses.

(6) Inspect regulator-aspirator inlet filter for contamination. Replace or clean filter as necessary.

(7) Connect aspirator line to aspirator and to dual filter and relief valve.

B. Empennage Pressure and Return Lines (See Figures 602 Through 604.)

NOTE: This procedure covers the lines from the dual filter and relief valve (outlet side) to the rudder and horizontal stabilizer filter, located in the pressure line in the empennage, and the B-return and low-pressure return lines from the empennage bulkhead back to the left wheel well.

(1) Disconnect pressure line from check valve, located on top side of dual filter and relief valve. Connect this line to test stand pressure hose.

(2) Inspect, clean, and/or replace check valve.

(3) Place system selector valve in general system (normal) position.

(4) Disconnect lines which run from tees in low-pressure return line and empennage pressure line to spoiler interconnect valve. Cap tees. Spoiler interconnect valve is located on inboard side of left wheel well.

(5) In empennage, disconnect pressure line at empennage filter. Install jumper between this line and B-return line at pressure bulkhead.

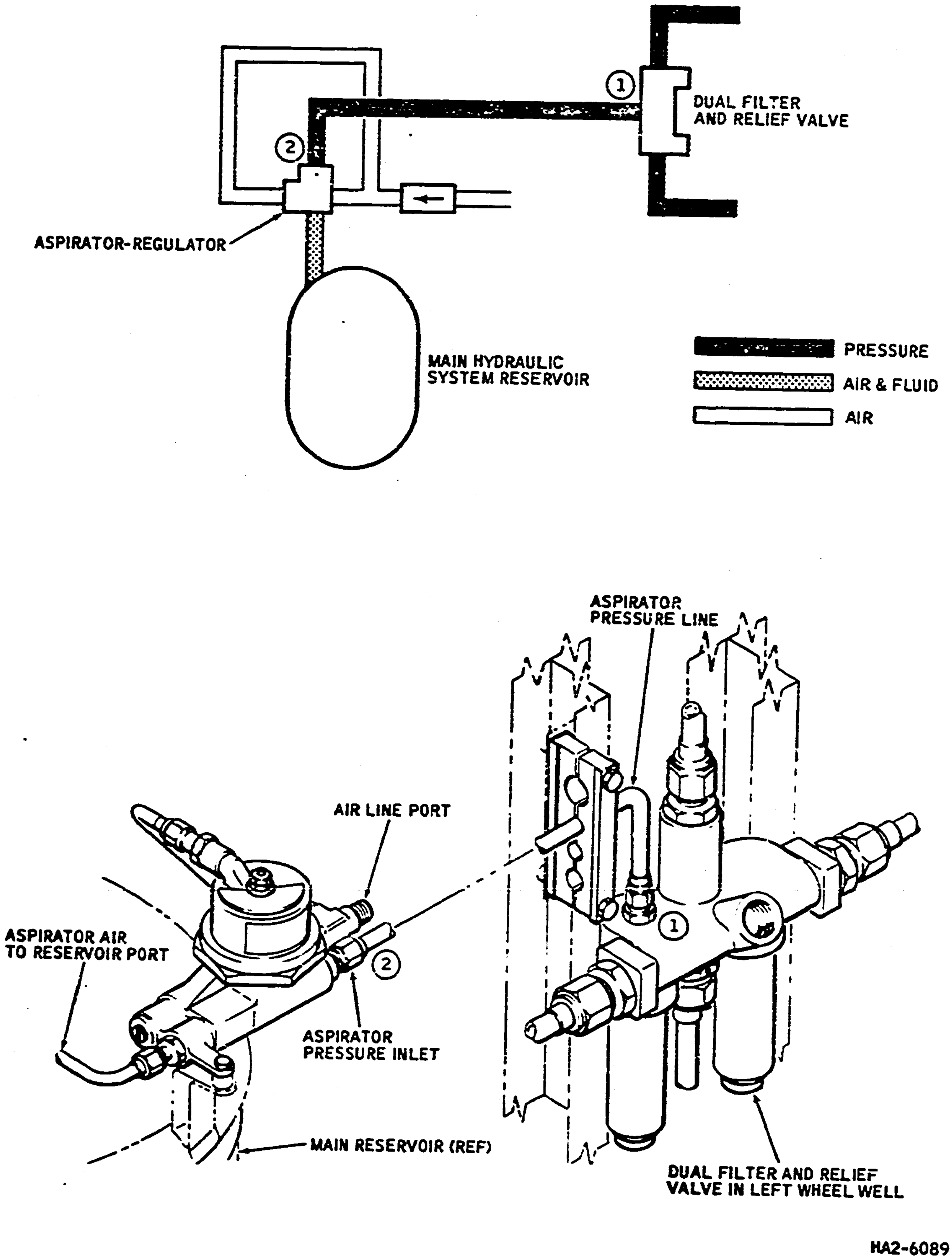
(6) Disconnect empennage B-return line at tee fitting in B-return line, located below left power manifold. Connect aft line to test stand return hose. Cap tee fitting.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

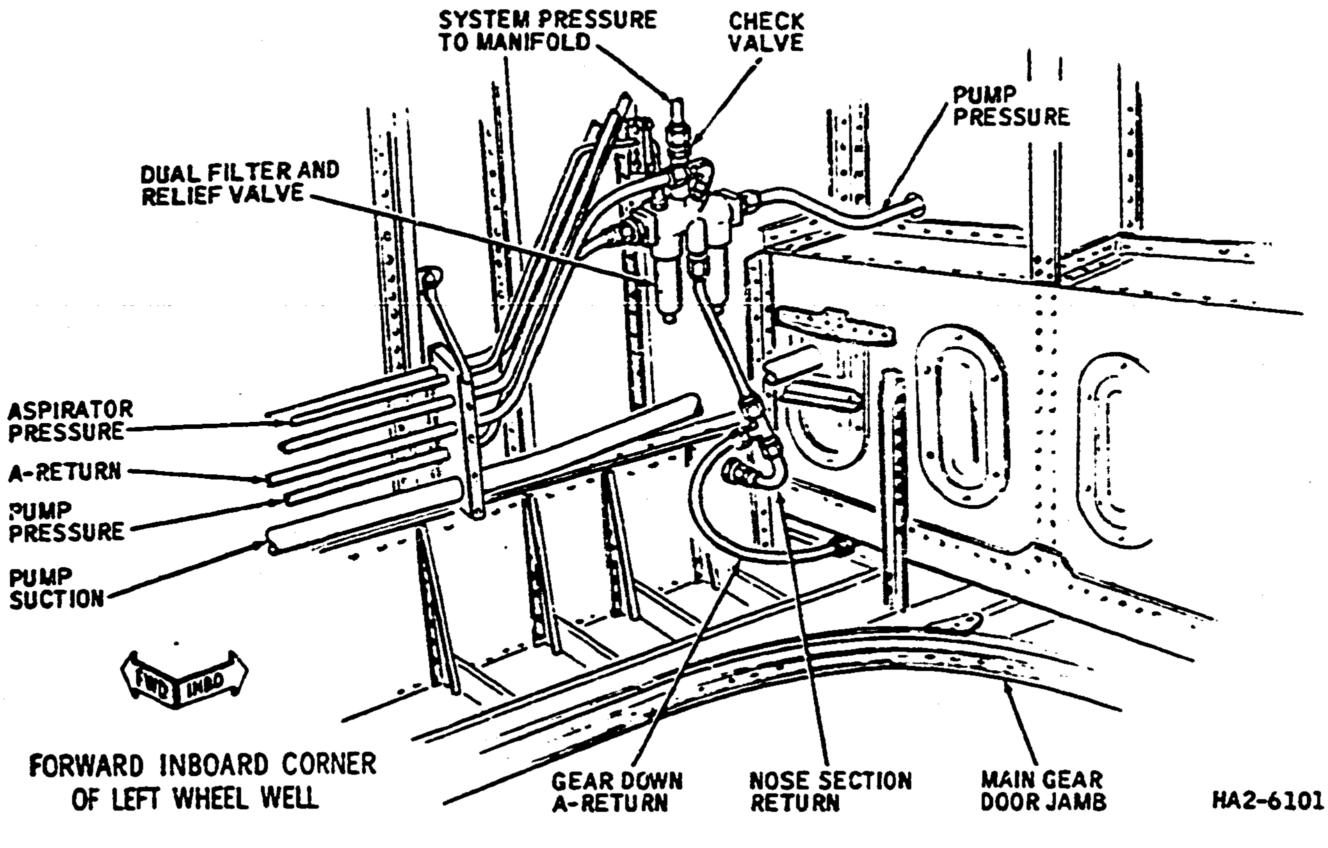
(8) Flush circuit for five minutes.

(9) Depressurize test stand.

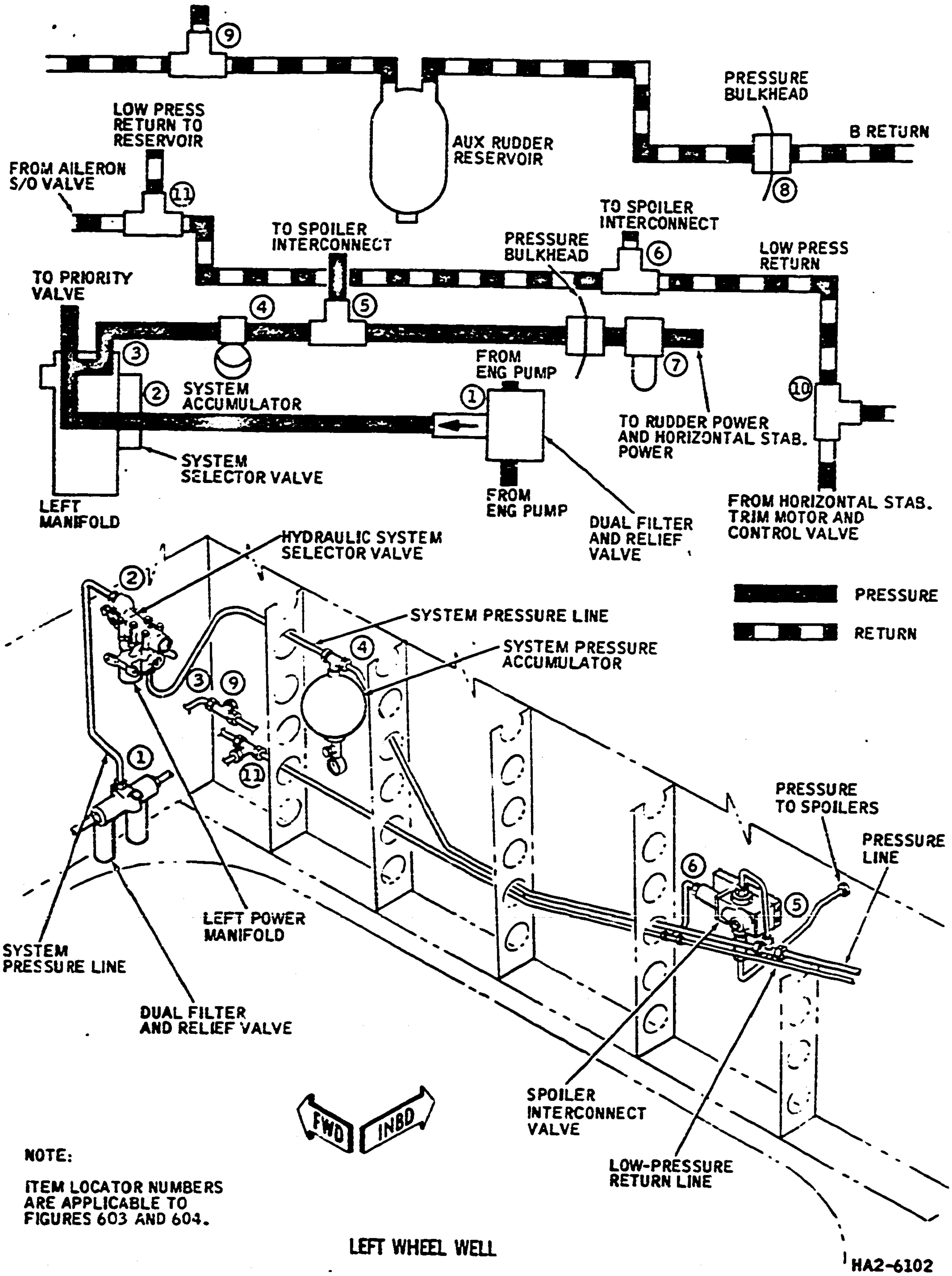
(10) In empennage, disconnect jumper line from B-return line, and connect to low-pressure return line.



Flushing Procedure Line Connection Locations
Figure 601



Flushing Procedure Line Connection Locations
Figure 602



NOTE:

ITEM LOCATOR NUMBERS ARE APPLICABLE TO FIGURES 603 AND 604.

LEFT WHEEL WELL

Flushing Procedure Line Connection Locations
Figure 603

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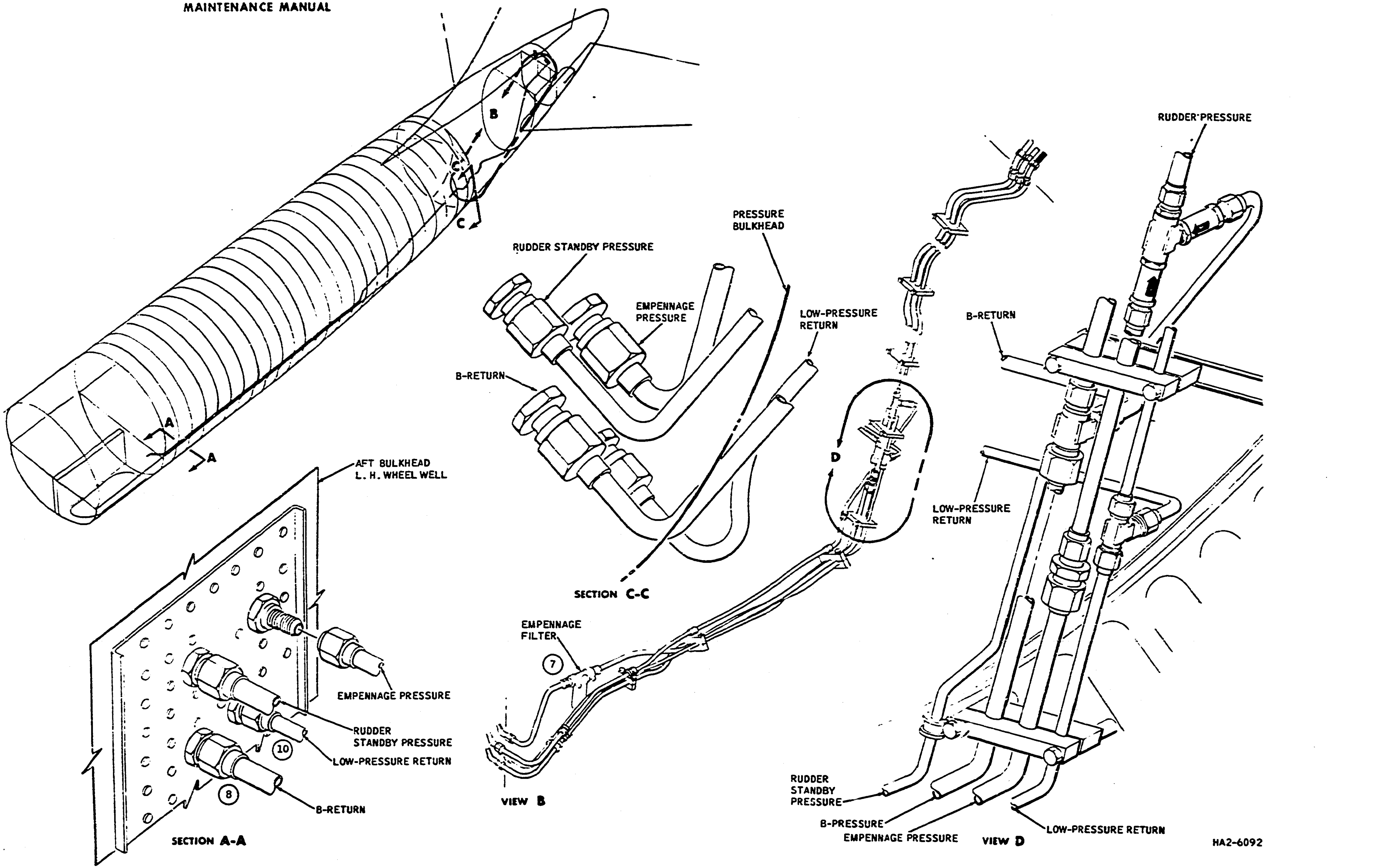

Flushing Procedure Line Connection Locations
Figure 604

(11) Disconnect 1/4-inch low-pressure line (empennage drain) from tee fitting in low-pressure return line (case drain), located to left of centerline of airplane and aft of rear spar.

(12) Disconnect test stand return hose from B-return hose, and connect it to low-pressure return line located inboard of dual filter and relief valve.

(13) Repeat Steps (8 through 10).

(14) Clean or replace empennage filter element and bowl.

(15) Inspect, clean, and/or replace hydraulic system accumulator.

(16) Restore all lines and units to original configuration.

NOTE: For continuation of flushing rudder and horizontal stabilizer systems, refer to 29-05.

C. Aileron Pressure and Return Lines (See Figures 605 and 607.)

(1) Disconnect aileron pressure line at inboard port of left aileron filter, and disconnect aileron return line from aileron swivel gland. Connect these two lines together with jumper.

(2) Disconnect lines from both ends of check valve in outlet line of thrust reverser reservoir. Connect jumper line between these lines (see Figure 607).

(3) Disconnect left aileron pressure line at aileron shutoff valve located in left wheel well (see Figure 605). Connect this line to test stand pressure hose.

(4) Disconnect A-return line at reservoir. Connect this line to test stand return hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Disconnect pressure line at inboard port of right aileron filter, and disconnect aileron return line from aileron swivel gland. Connect these two lines togehter.

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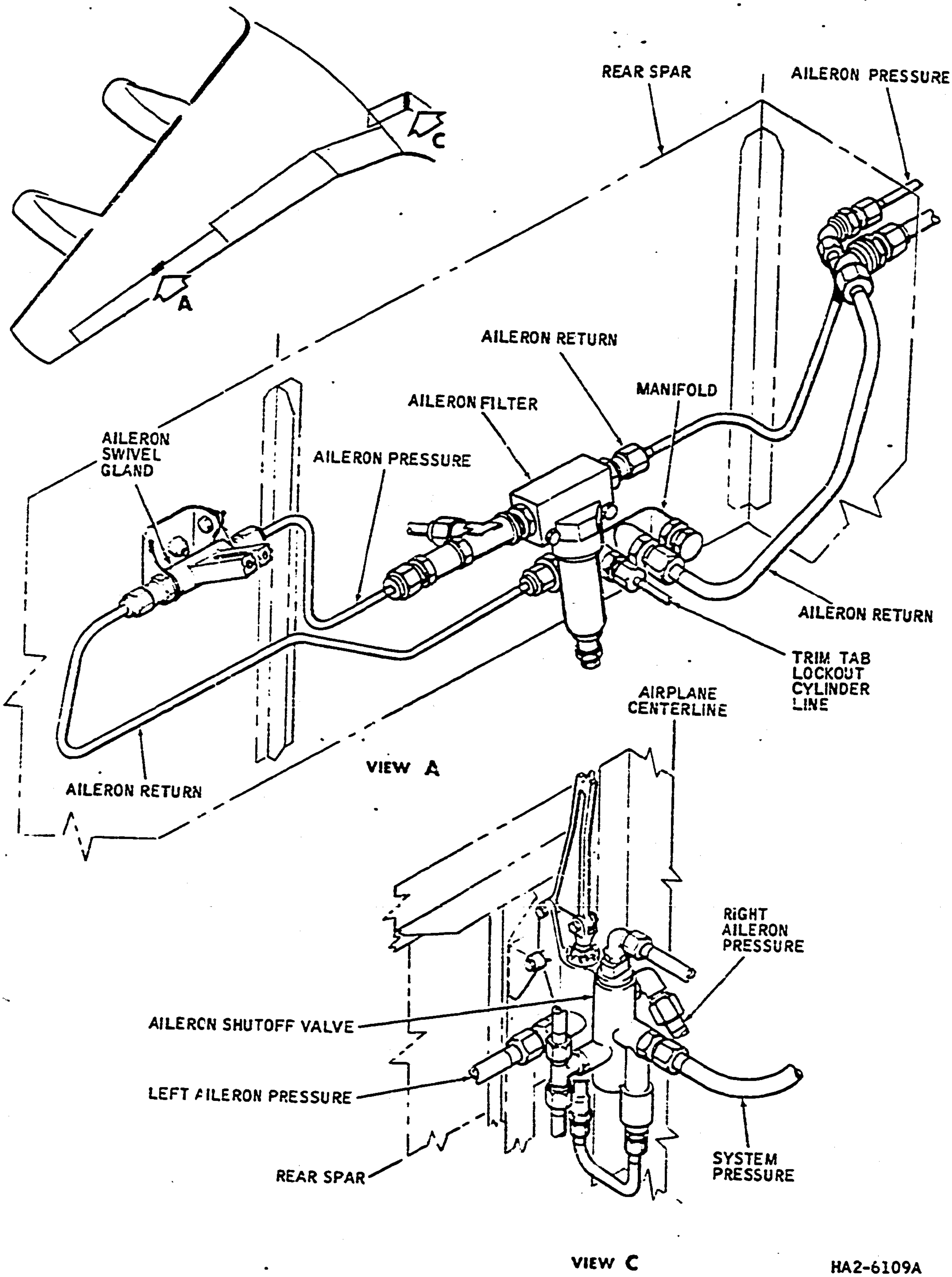

Flushing Procedure Line Connection Locations
Figure 605

(9) Disconnect right aileron pressure line at aileron shutoff valve, located in left wheel well. Connect line to test stand pressure hose.

(10) Disconnect right aileron return line from tee forward of flap reservoir (see Figure 607). Connect line to test stand return hose.

(11) Repeat Steps (6 through 8) for these lines.

(12) Restore all lines and units to original configuration.

(13) Remove magnetic drain plug from thrust reverser reservoir and drain reservoir. Clean plug, reinstall and safety with lock wire (see Chapter 78).

(14) Clean and/or replace aileron filter elements.

(15) Clean or replace check valve jumpered in step (2).

NOTE: For continuation of flushing aileron system components, refer to 29-05.

D. Nose System Pressure and Return Lines (See Figure 606.)

(1) In nosewheel well, disconnect 1/4-inch return line which runs from nose gear control valve to bulkhead tee fitting in A-return line, at tee. Cap tee.

(2) Disconnect pressure line leading into nose gear control valve at valve. In this same line, replace check valve with jumper line.

(3) Disconnect pressure line which runs to tee in pressure accumulator, from pressure bulkhead tee at rear of wheel well. Cap tee.

(4) Connect two open lines from Step (2) and Step (3) with jumper.

(5) Disconnect at tee, pressure line which runs from reserve pressure accumulators to tee near centerline of airplane. Cap tee.

(6) Disconnect pressure line leading into reserve accumulator shutoff valve.

(7) Disconnect return line from tee in steering relief valve. Connect this line to pressure line at shutoff valve with jumper line.

(8) On freighter type airplanes, disconnect cargo door pressure line at tee fitting in nose system pressure line. Cap tee and cargo door pressure line.

NOTE: The cargo door pressure line tee fitting is located in the forward left side of the forward baggage compartment.

(9) In left main gear wheel well, disconnect nose system pressure line from side port of tee in priority valve. Connect line to test stand pressure hose.

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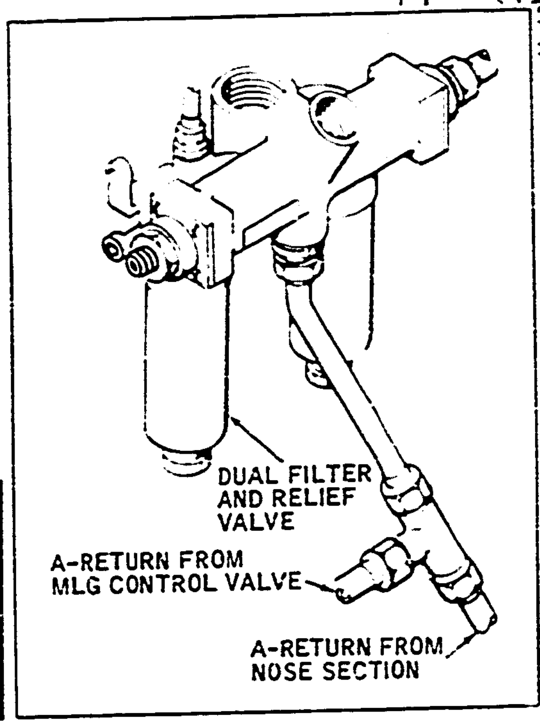
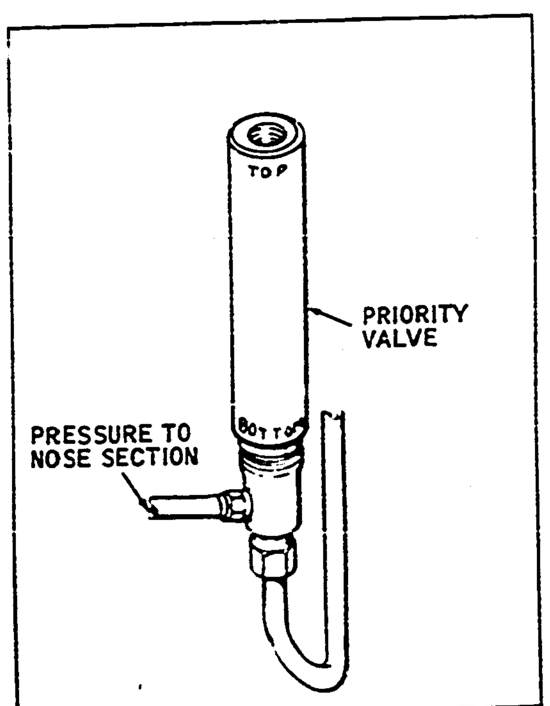
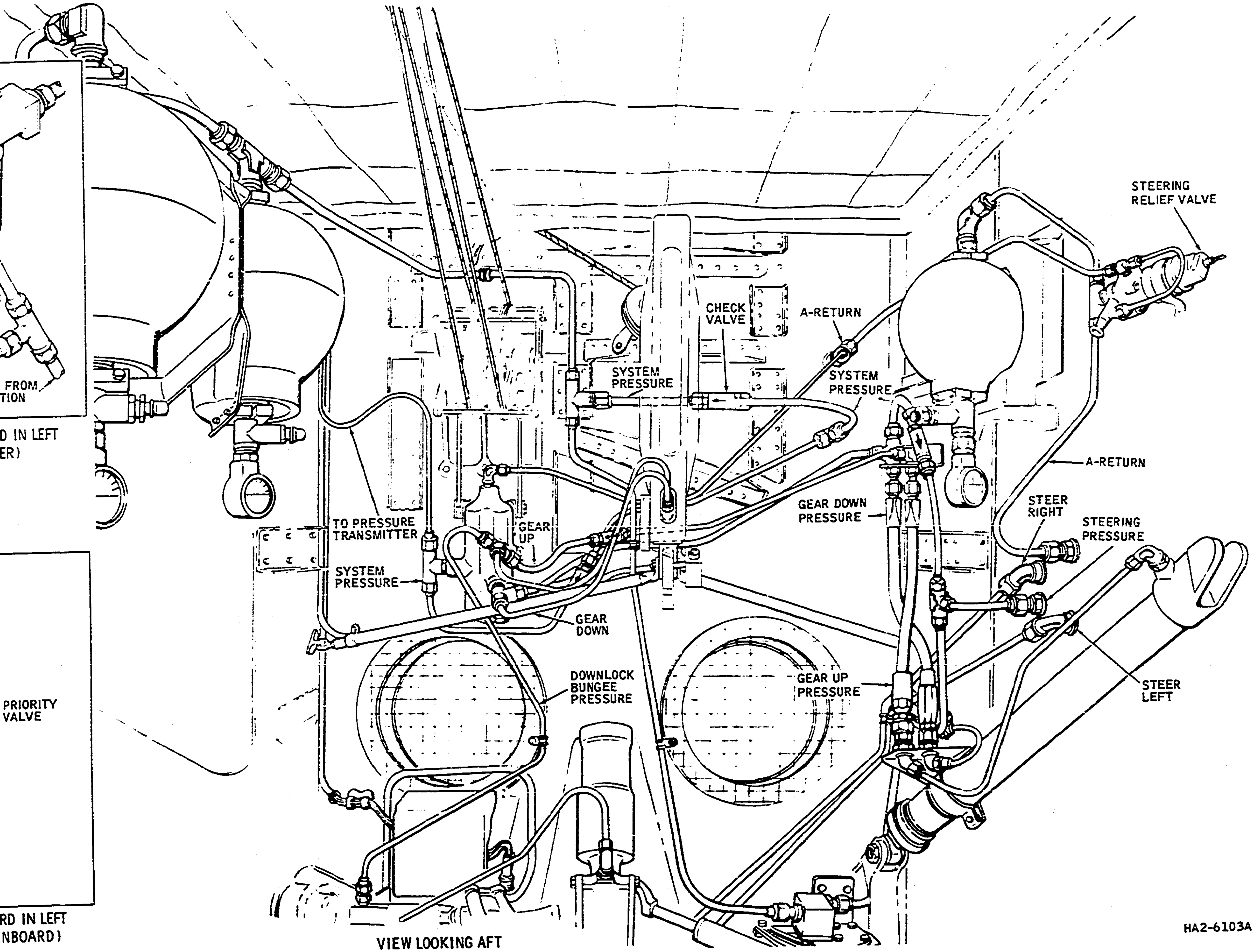


VIEW LOOKING FORWARD IN LEFT WHEEL WELL (LOWER)

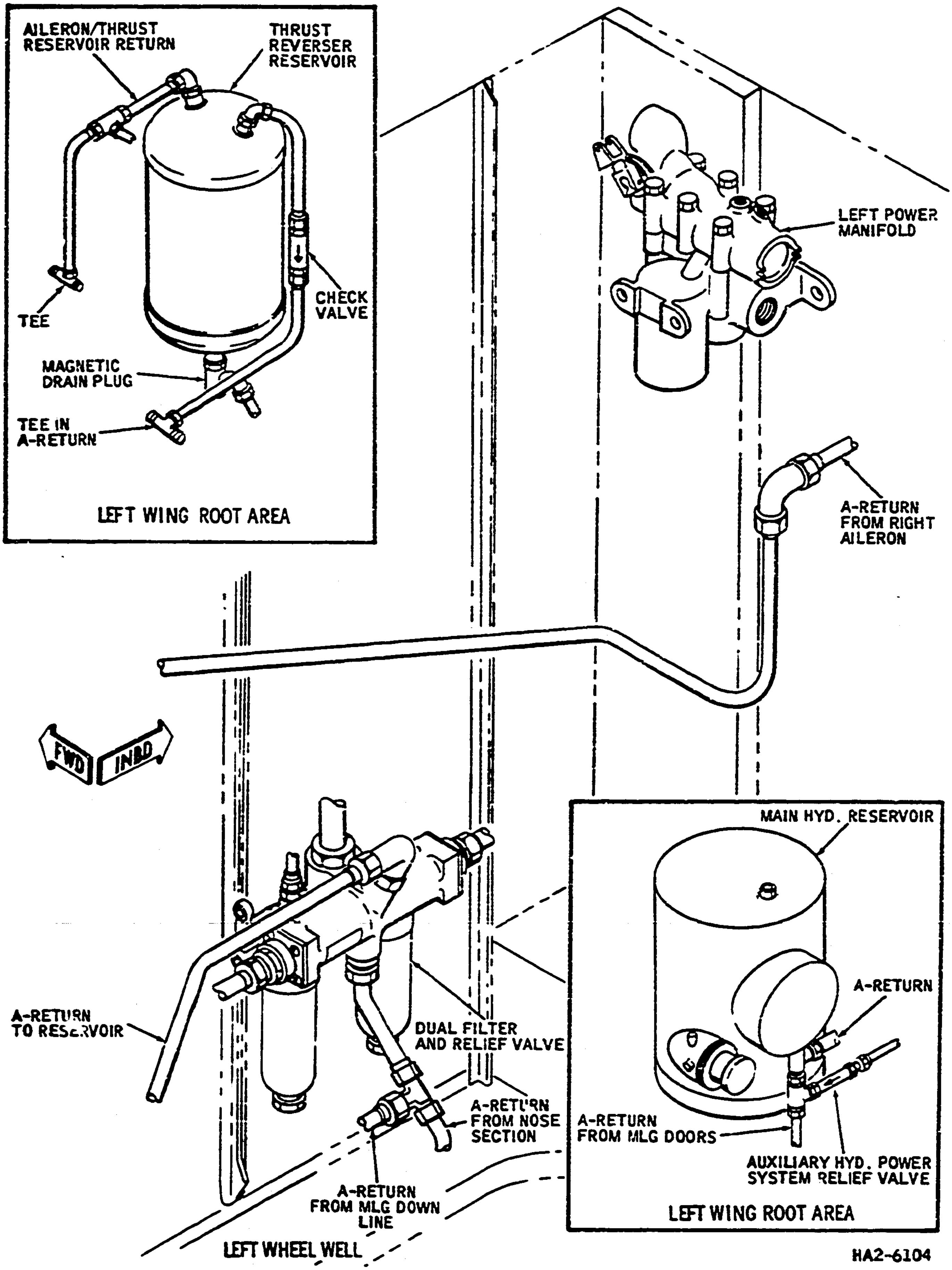


VIEW LOOKING FORWARD IN LEFT WHEEL WELL (UPPER INBOARD)



VIEW LOOKING AFT

Flushing Procedure Line Connection Locations
Figure 606



Flushing Procedure Line Connection Locations
Figure 607

(10) Disconnect nose system A-return line from bottom of dual filter and relief valve. Connect line to test stand return hose.

(11) Disconnect main gear control valve A-return line from tee in nose gear A-return line. Cap tee.

(12) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(13) Flush circuit for five minutes.

(14) Depressurize test stand.

(15) Remove, inspect, clean, and/or replace miniature check valve, located in nose system return port of dual filter and relief valve.

(16) Repeat Step (15), inspection etc., for following items:

(a) Check valve jumpered in nosewheel well.

(b) Two reserve pressure accumulators and attaching lines.

(c) System pressure transmitter and attaching lines.

(17) Restore all lines and units to original configuration.

NOTE: For continuation of flushing of nose gear system, refer to 29-04.

E. Flush A-Return Line (See Figure 607.)

(1) Disconnect aileron A-return line from bulkhead elbow in A-return line, located below left power manifold. Cap elbow.

(2) Connect line to test stand pressure hose.

(3) Disconnect lines from both ends of check valve in outlet line of thrust reverser reservoir. Connect jumper between lines.

(4) Disconnect A-return line from reservoir fittings. Connect line to test stand return hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Restore all lines and units to original configuration except return hose to reservoir.

(9) Remove magnetic drain plug from thrust reverser reservoir and drain reservoir. Clean plug, reinstall and safety with lockwire (see Chapter 78).

(10) Disconnect line from elbow at top of dual filter and relief valve. Connect line to pressure stand pressure hose.

(11) Repeat Steps (5 through 7).

(12) Restore all lines and units to original configuration.

F. Flush B-Return Line (See Figure 608.)

(1) Disconnect B-return line from miniature check valve installed in right power manifold. Connect this line to test stand pressure hose.

(2) Disconnect empennage return line from tee in B-return line. Cap tee.

(3) Disconnect brake return line from tee fitting located adjacent to main reservoir. Cap tee.

(4) Disconnect B-return line from check valve in reservoir B-return port. Connect line to test stand return hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for five minutes.

(7) Depressurize test stand.

(8) Remove check valve from reservoir B-return port and miniature check valve (Step 1). Inspect, clean, and/or replace check valves.

(9) Restore all lines and units to original configuration.

G. Power Manifolds

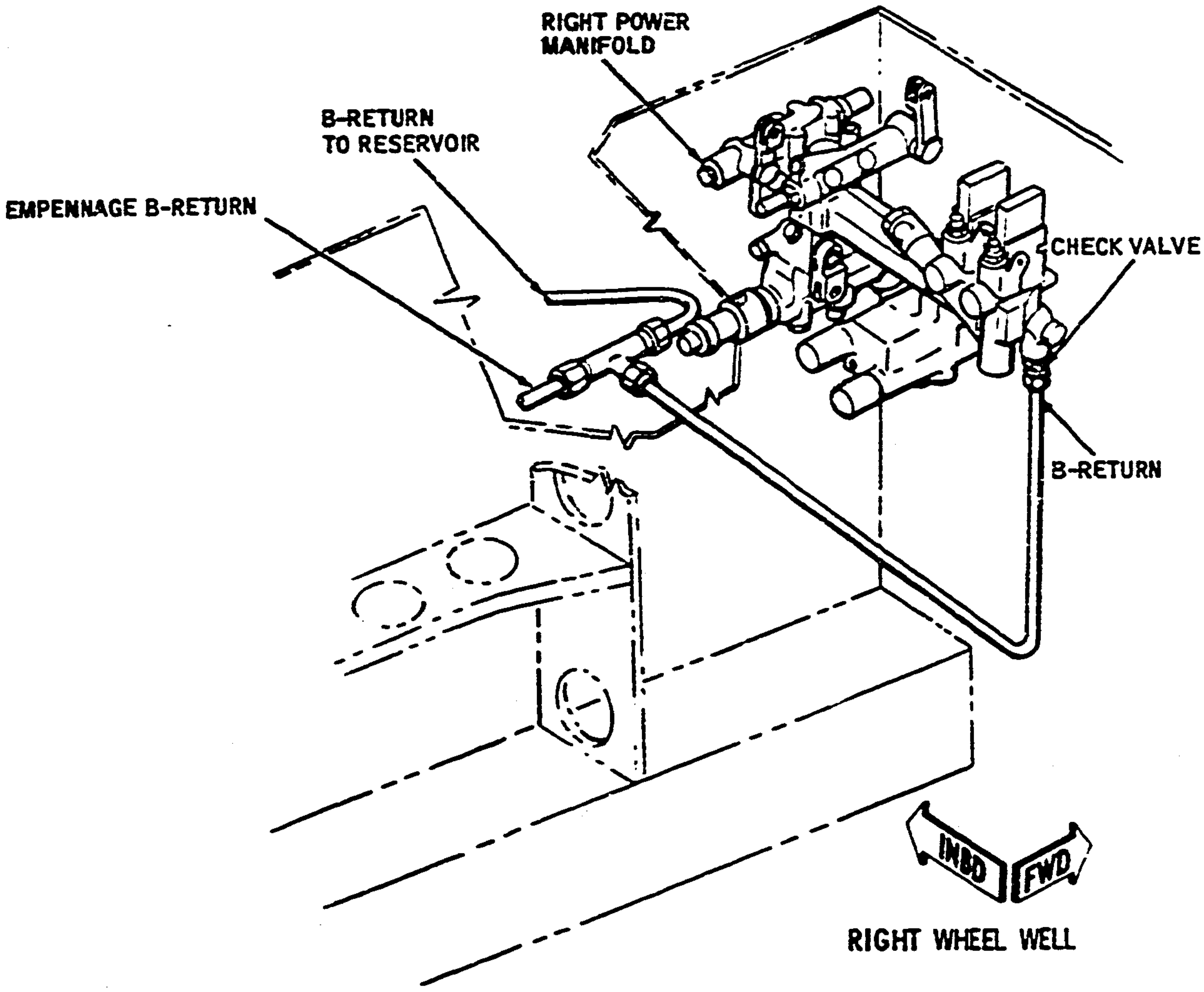
(1) If contamination downstream of the dual filter and relief valve is general, the right and left power manifolds with attaching valves must be removed, inspected, cleaned, and/or replaced.

H. Flush Low-Pressure Return Lines (See Figure 609.)

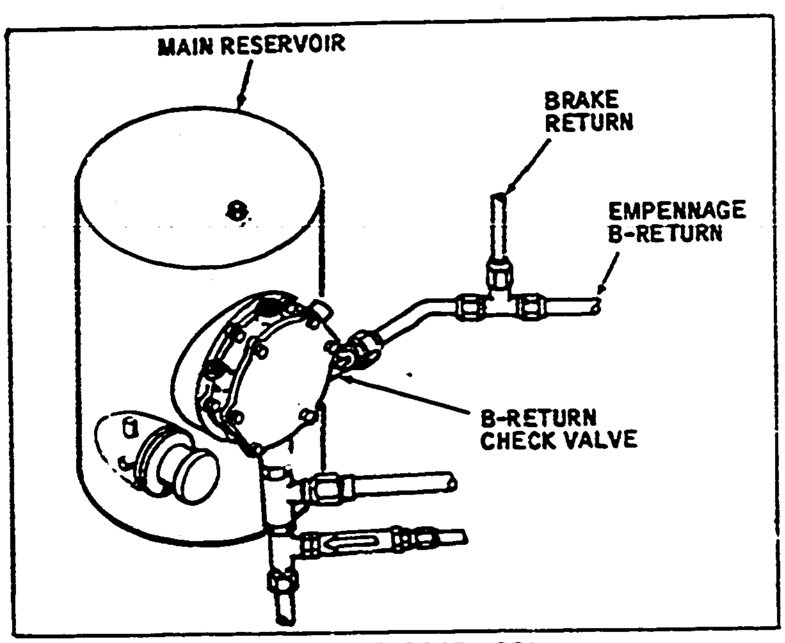
(1) In right wing root area, disconnect low-pressure return line from wing flap thermal relief valve. Connect this line to test stand pressure hose. Thermal relief valve is located on the rear spar.

(2) In left wheel well, below dual filter and relief valve, disconnect low-pressure return line from top of tee which connects aileron valve drain and empennage drain returns to cross-ship low-pressure return. Cap tee.

(3) Disconnect low-pressure return line from tee fitting that joins wing flap return at main reservoir. Cap tee, and connect line to test stand return hose.



RIGHT WHEEL WELL



LEFT WING ROOT AREA

HA2-6105

Flushing Procedure Line Connection Locations
Figure 608

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(4) Pressurize test stand to 200 psi at 20 gpm flow.

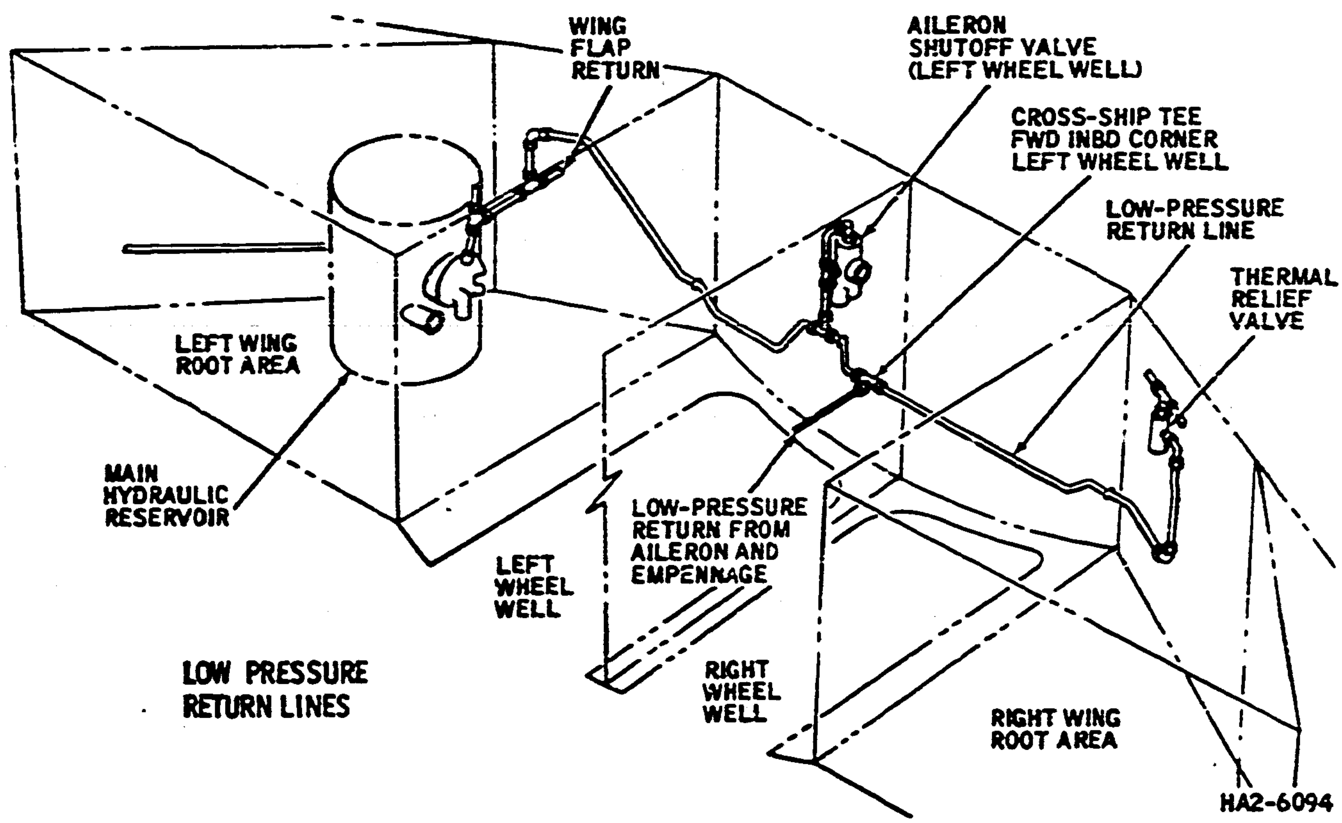
(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Remove line from tee in aileron shutoff valve to tee fitting in low-pressure return line, in left wheel well. Flush line.

(8) Remove, clean and/or replace aileron shutoff valve and thermal relief valve.

(9) Restore all lines and units to original configuration.



Flushing Procedure Line Connection Locations
Figure 609

AUXILIARY HYDRAULIC POWER SYSTEM - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the auxiliary hydraulic power system by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Auxiliary Hydraulic Power System

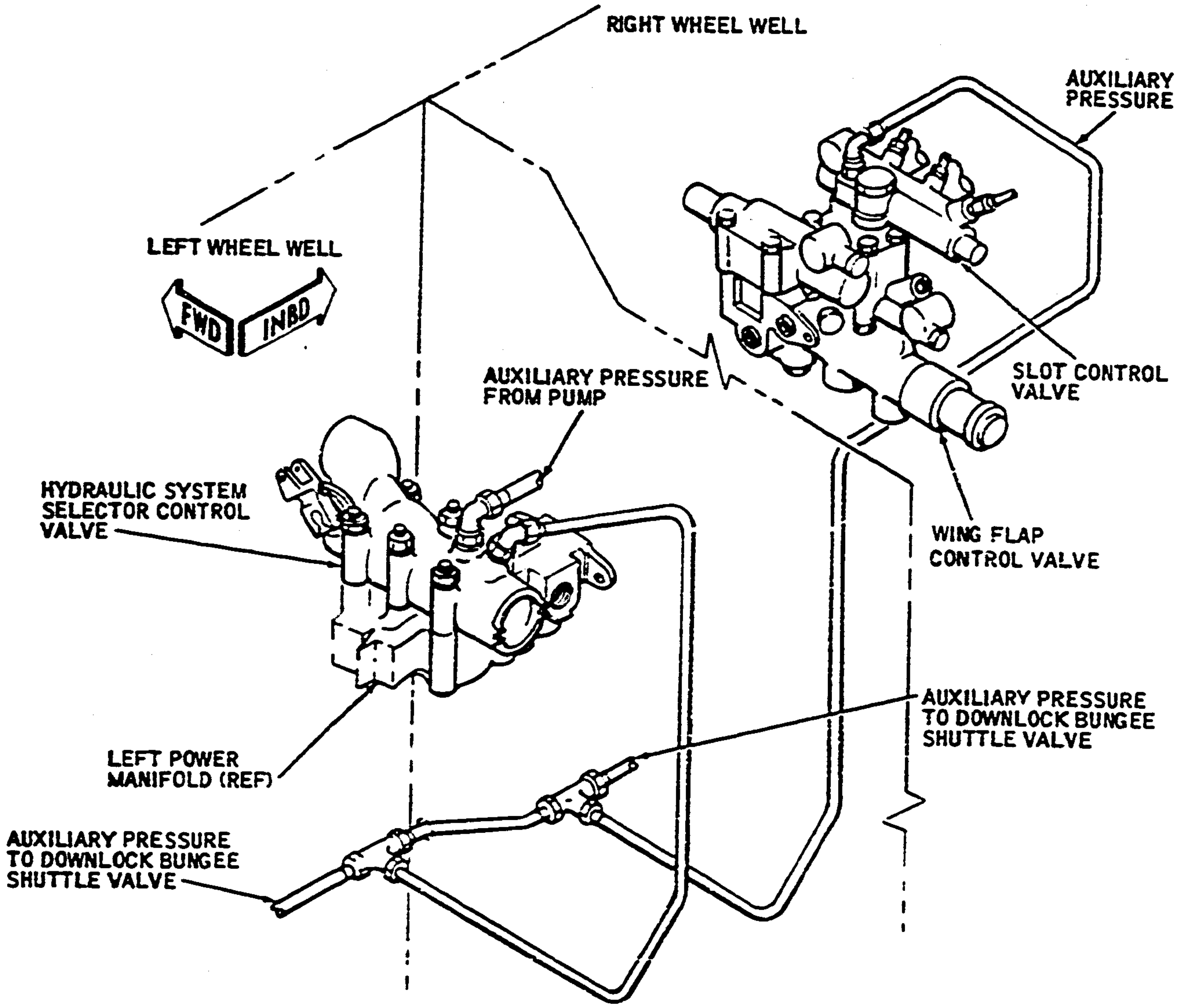
A. Auxiliary Pressure Lines to Wing Flap System

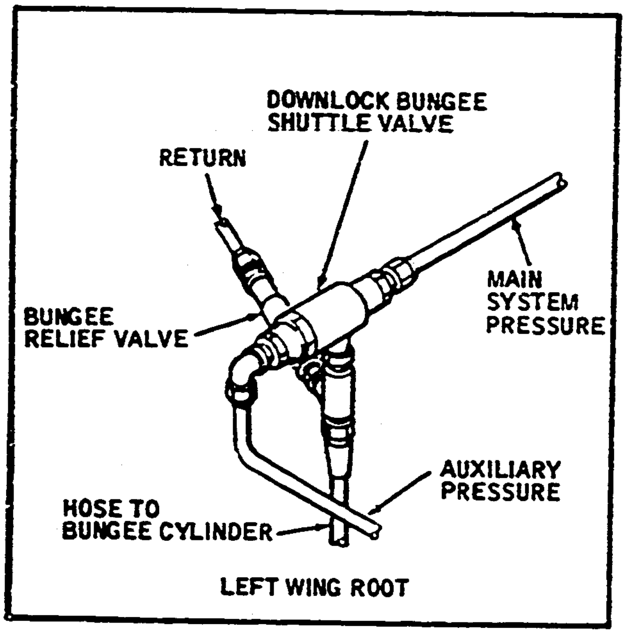
(1) Disconnect pressure line from downstream side (forward) of the auxiliary hydraulic pump filter. Connect this line to test stand pressure hose.

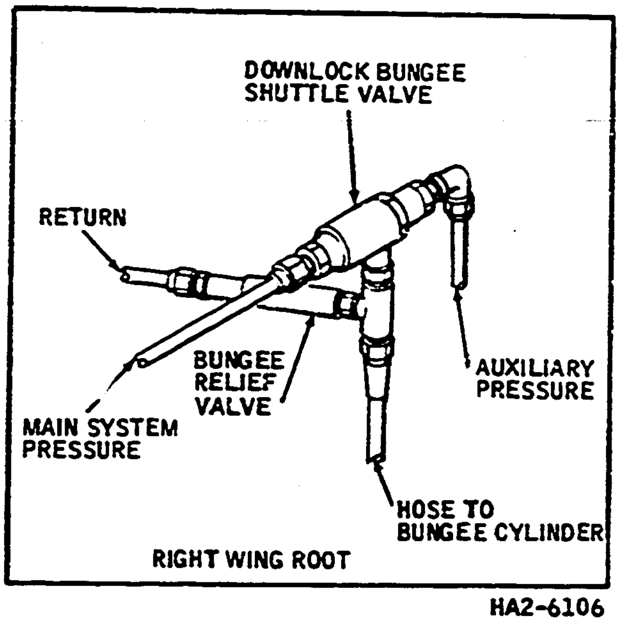
(2) Clean auxiliary pump filter (see 29-20-5).

(3) Remove check valve from auxiliary pressure line, and install a jumper line in its place. Check valve is located above filter.

(4) Disconnect auxiliary pressure lines from inlet and outlet ports of system selector valve, and install jumper line between these lines. Cap valve ports.







HA2-6106

Flushing Procedure Line Connection Locations
Figure 601

(5) Disconnect left main gear downlock bungee cylinder auxiliary pressure lines from tee fitting, located to left of airplane centerline. Cap tee.

(6) Disconnect right main gear downlock bungee cylinder auxiliary pressure line from tee fitting, located to right of airplane centerline. Cap tee.

(7) Disconnect auxiliary pressure line from auxiliary wing flap inlet port, adjacent to slot control valve, on right power manifold. Connect this line to test stand return hose.

(8) Pressurize test stand to 200 psi maximum at 3 to 10 gpm flow.

(9) Flush this circuit for 5 minutes.

(10) Depressurize test stand.

(11) Remove jumper lines, clean, and/or replace check valve removed in Step (3).

(12) Connect all lines except right and left main gear bungee cylinder lines.

B. Auxiliary Pressure Lines to Main Gear Downlock Bungee Cylinders

(1) Connect left main gear downlock bungee cylinder auxiliary pressure line, which was disconnected in paragraph A, Step (5) to test stand pressure hose.

(2) Disconnect left bungee cylinder auxiliary pressure line from shuttle valve, located in left wing root. Connect this line to test stand return hose.

(3) Pressurize test stand to 200 psi maximum at 3 to 10 gpm flow.

(4) Flush this circuit for 5 minutes.

(5) Depressurize test stand.

(6) Repeat steps (1 through 5) for right bungee line.

(7) Inspect, clean, and/or replace shuttle valve, bungee relief valve, and bungee cylinder.

(8) Restore all lines and units to their original configuration.

AUXILIARY HYDRAULIC POWER SYSTEM - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminated (foreign particles) from the fluid, units, and lines of the auxiliary hydraulic power system by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Auxiliary Hydraulic Power System

A. Auxiliary Pressure Lines to Wing Flap System

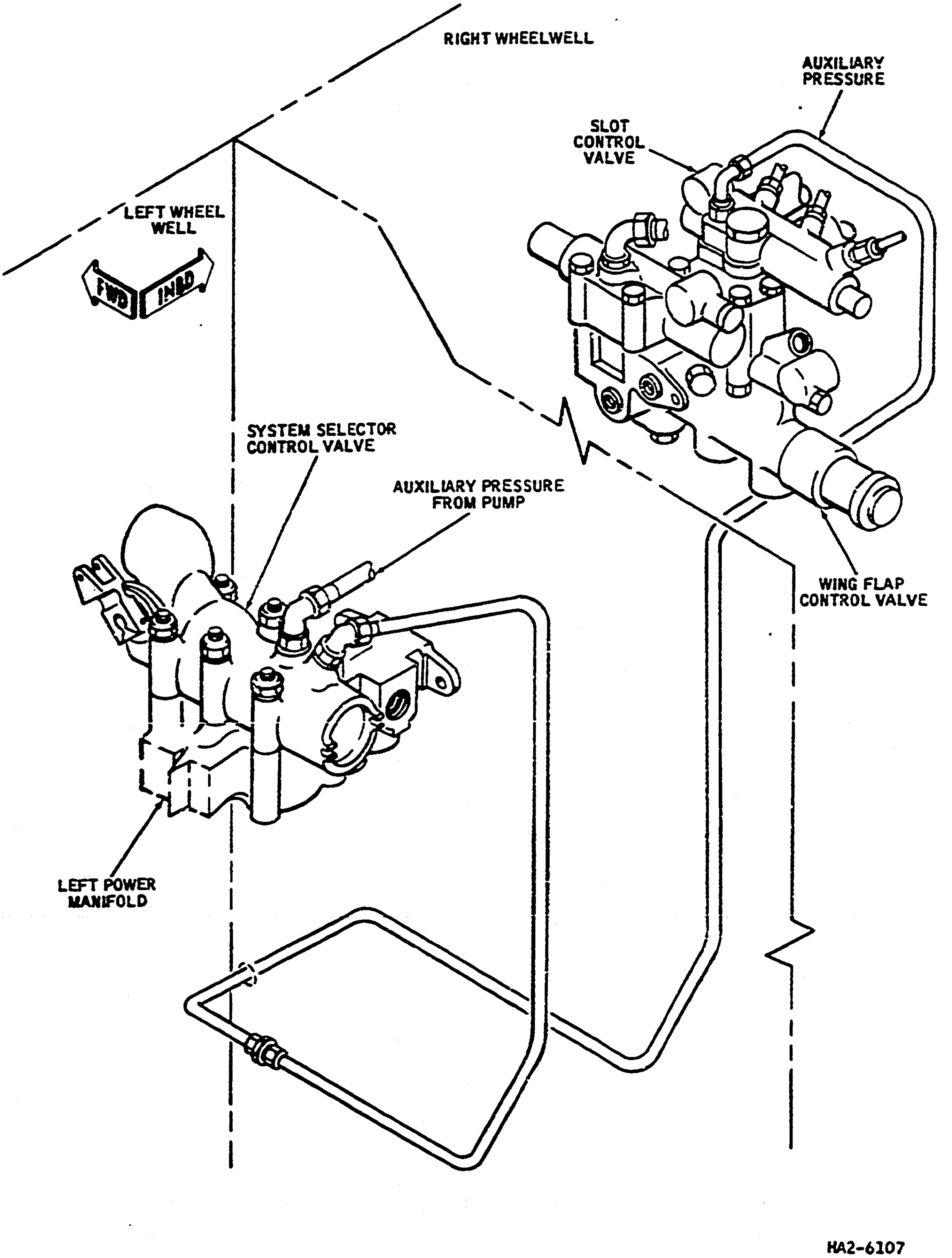
(1) Disconnect pressure line from downstream side (forward) of auxiliary hydraulic pump filter. Connect this line to test stand pressure hose.

(2) Clean auxiliary pump filter (see 29-20-5).

(3) Remove check valve located above above filter from auxiliary pressure line, and install jumper line in its place.

(4) Disconnect auxiliary pressure lines from inlet and outlet ports of system selector control valve, and install jumper between these lines. Cap valve ports.

(5) Disconnect auxiliary pressure line from auxiliary wing flap inlet port in right power manifold. Connect line to test stand return hose.



Flushing Procedure Line Connection Locations
Figure 601

(6) Pressurize test stand to 200 psi maximum at 3 to 10 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Remove jumper lines, clean, and/or replace check valve removed in step (3).

(10) Restore all lines and units to original configuration.

UTILITY SYSTEMS UPSTREAM OF CONTROL SYSTEM FILTERS - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the utility systems upstream of the control system filters by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Utility Systems Upstream of Control System Filters

A. Wing Flap System

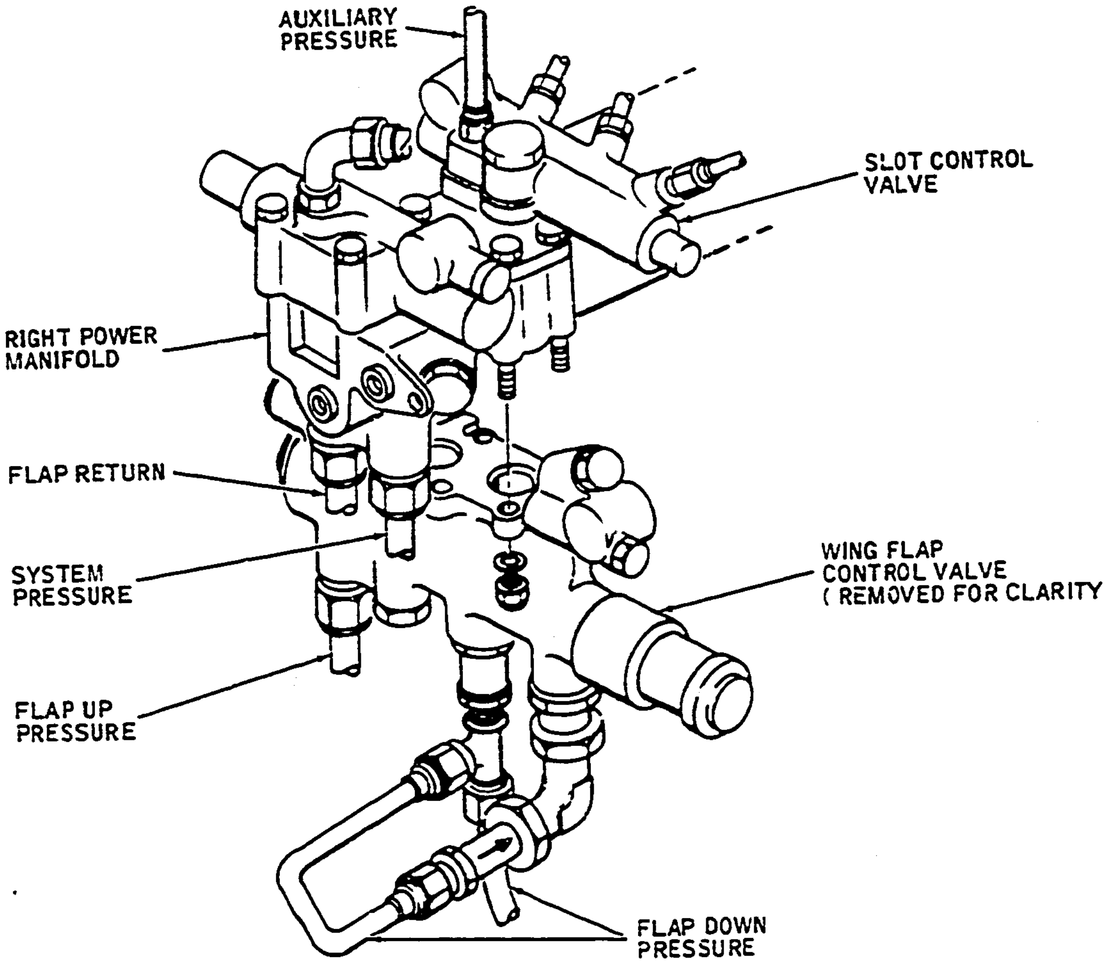
(1) Disconnect flap up and flap down lines from wing flap control valve (see Figure 601).

(2) Remove restrictor with portion of wing flap up line, which is connected to wing flap control valve.

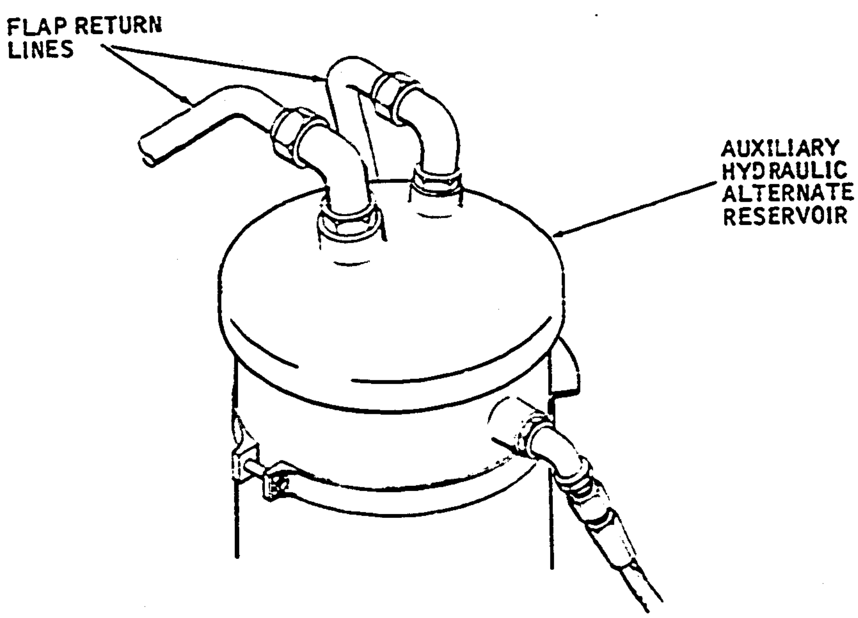
(3) Disconnect flap return line from right power manifold just inboard of flap control valve. Jumper this line to flap down line, which was disconnected in step (1).

(4) Connect open flap up line to test stand pressure hose.

(5) Disconnect flap return line from inlet port of auxiliary pump alternate reservoir. Connect this line to test stand return hose.



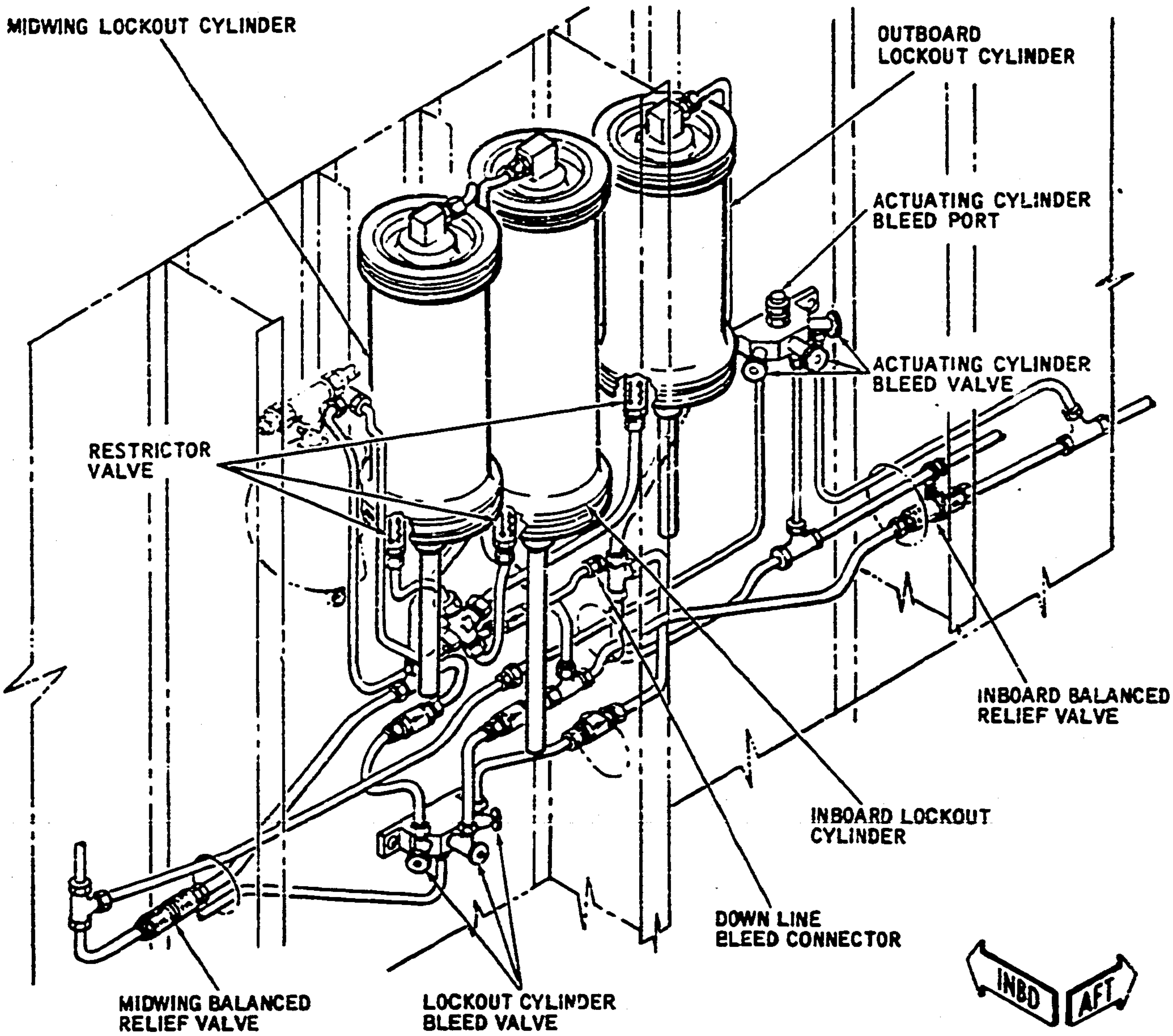
RIGHT POWER MANIFOLD



ALTERNATE RESERVOIR

HA2-6108A

Flushing Procedure Line Connection Locations
Figure 601



LEFT MAIN LANDING
GEAR WHEEL WELL

HA2-7558

Flushing Procedures -- Line Connection Location
Figure 601A

(6) Remove thermal relief valve from tee in flap up line, located at STA X_{rs} = 70 in right wing root. Cap tee.

(7) Disconnect hoses from outboard flap actuating cylinders. Plug all hoses.

(8) At inboard and midwing flap actuating cylinders, disconnect flap up and flap down pressure lines and install jumper between both set of lines.

(9) Disconnect bottom line from flap lockout cylinder bleed valve manifold (see Figure 601A).

(10) Remove lines and check valves (3) from top of bleed valve manifold.

(11) Connect jumper between line disconnected in step (9) and tee fitting below inboard lockout cylinder from which check valve was removed in step (10).

(12) Disconnect lines (3) from bottom of actuating cylinder bleed valve manifold.

(13) Connect jumper between bleed line for inboard actuating cylinder and down line bleed connector.

(14) Disconnect lines from top and bottom of inboard flap lockout cylinder and connect jumper between lines.

(15) At inboard and midwing balanced relief valve, disconnect and jumper lines.

(16) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(17) Shut off pressure source.

(18) Disconnect jumper from tee fitting below inboard lockout cylinder and connect to line below midwing lockout cylinder from which check valve was removed in step (10).

(19) Disconnect jumper from bleed line for inboard actuating cylinder and connect to bleed line for midwing actuating cylinder.

(20) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(21) Disconnect lines from top and bottom of inboard flap lockout cylinder and connect jumper between lines.

(22) Disconnect jumper from line below midwing lockout cylinder and connect to line below outboard lockout cylinder from which check valve was removed in step (10).

(23) Disconnect jumper from bleed line for midwing actuating cylinder and connect to bleed line for outboard actuating cylinder.

(24) At midwing flap actuating cylinders, remove jumpers. Plug flap down pressure lines.

(25) Connect jumper between midwing actuating cylinder up pressure line and outboard actuating cylinder down pressure lines.

(26) Pressure test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(27) Shut off pressure source.

(28) Disconnect test stand pressure hose from flap up line. Connect line to wing flap control valve.

(29) Disconnect auxiliary pump case drain line from inlet port on side of alternate reservoir and from case drain of auxiliary pump.

(30) Connect test stand pressure hose and return hose to drain line, flush for three minutes.

(31) Disconnect auxiliary pump suction line at alternate reservoir and auxiliary pump selector valve.

(32) Disconnect test stand pressure hose and test stand return hose from auxiliary pump case drain line, and connect to auxiliary pump suction line, flush for three minutes.

(33) Remove jumpers at all flap actuating cylinders, flap lockout cylinders, flap control valve, and actuating cylinder bleed valve manifold. Connect airplane lines to applicable component.

(34) Bench flush short lines that run between lockout cylinder bleed valve manifold and check valve (removed in step 10).

(35) Install lines and check valves on lockout cylinder bleed balve manifold.

(36) Remove and bench flush short line that runs between thermal relief valve and tee in low-pressure return line.

<u>NOTE:</u> Steps (37) through (47) have been deleted.

(48) Inspect, clean, and/or replace all flap actuator cylinders, lockout cylinders, thermal relief valve, balance relief valves, restrictor valve, and flap control valve.

(49) Restore all lines and units to original configuration.

(50) Adjust rigging if necessary (see Chapter 27).

B. Wing Slot System

(1) Disconnect slots open and slots closed lines from wing slot control valve, located on right power manifold (see Figure 601).

(2) Connect slots open line to test stand pressure hose. Connect slots closed line to test stand return hose.

(3) Disconnect lines from 4 slot cylinders, cap all lines except outboard right cylinder lines. Install jumper across these two lines.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for three minutes.

(6) Depressurize test stand.

(7) Move jumper to right inboard slot cylinder lines, cap outboard lines, and repeat steps (4 through 6).

(8) Repeat steps (3 through 7) for left side. Make certain that all lines on both sides of airplane, with exception of jumpered lines, are capped.

(9) Inspect, clean, and/or replace wing slot cylinders and wing slot control valve, located on right power manifold.

(10) Restore all lines and units to original configuration. Adjust rigging if necessary per Chapter 27.

C. Main Gear Retract System (See Figures 602 and 603.)

(1) Disconnect gear up pressure line, gear down pressure line, and gear down return lines from main gear control valve.

(2) Connect jumper between gear down pressure line and gear down A-return line.

(3) Connect gear up line to test stand pressure hose.

(4) Disconnect gear down A-return line from tee in (nose gear return) A-return line, located in left wheel well aft of rear spar and below dual filter and relief valve. Connect line to test stand return hose.

(5) Disconnect right gear up and gear down lines from tees, located to right of centerline of airplane. Cap tees. Left gear retract system will be flushed first.

(6) In left wheel well, disconnect both main gear uplatch lines from tees in gear up and gear down lines. Cap tees.

(7) Disconnect both main gear door latch lines from tees in gear up and gear down lines near wing root. Cap tees.

(8) Disconnect downlock bungee pressure line from tee in gear up line. Cap tee.

(9) Disconnect line, which leads to bungee cylinder, from tee in gear down line. Cap tee.

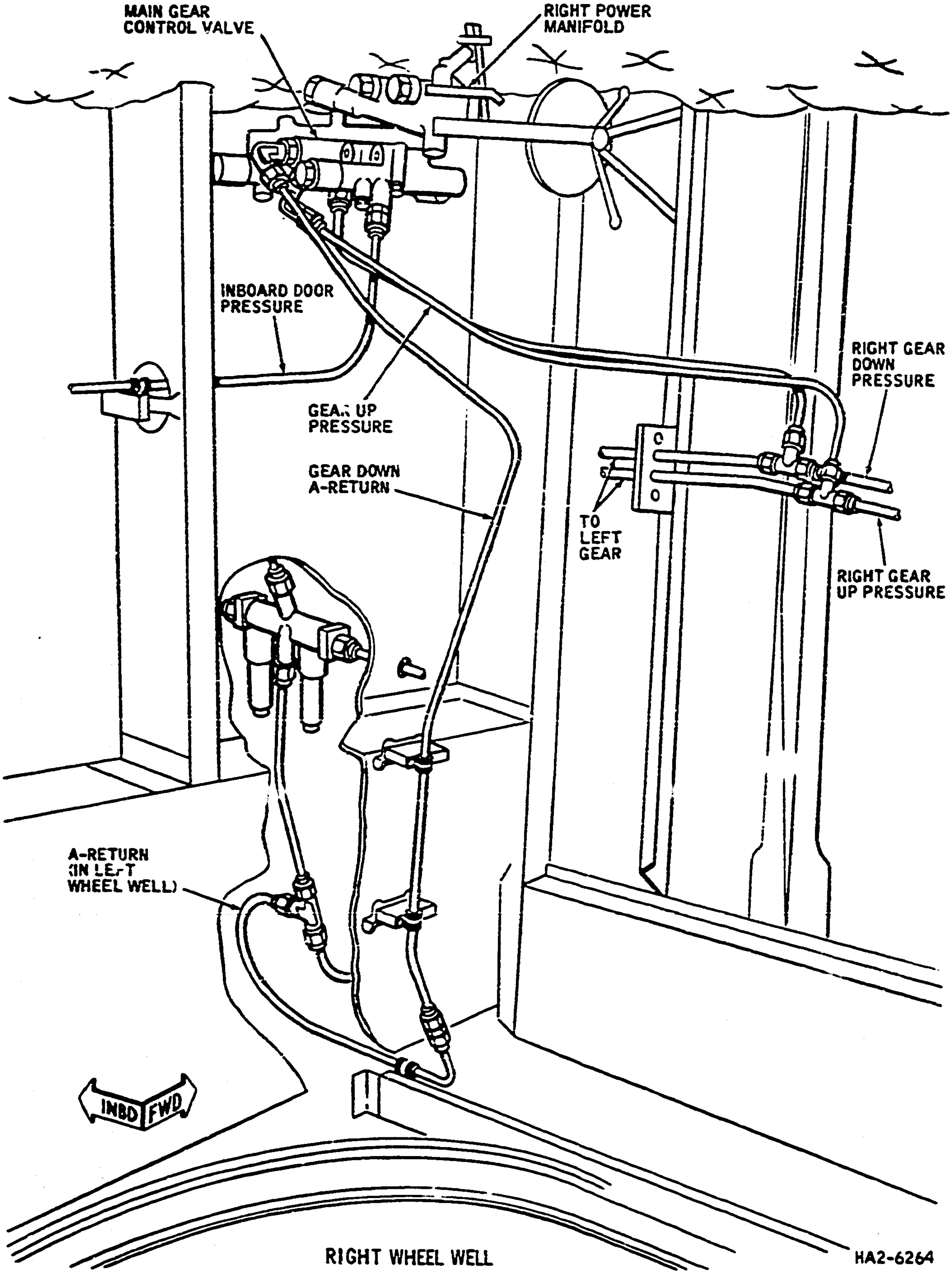
(10) Disconnect line, which leads to gear door manual open valve, from tee in main gear down line. Cap tee.

(11) Replace restrictor in gear down line with jumper.

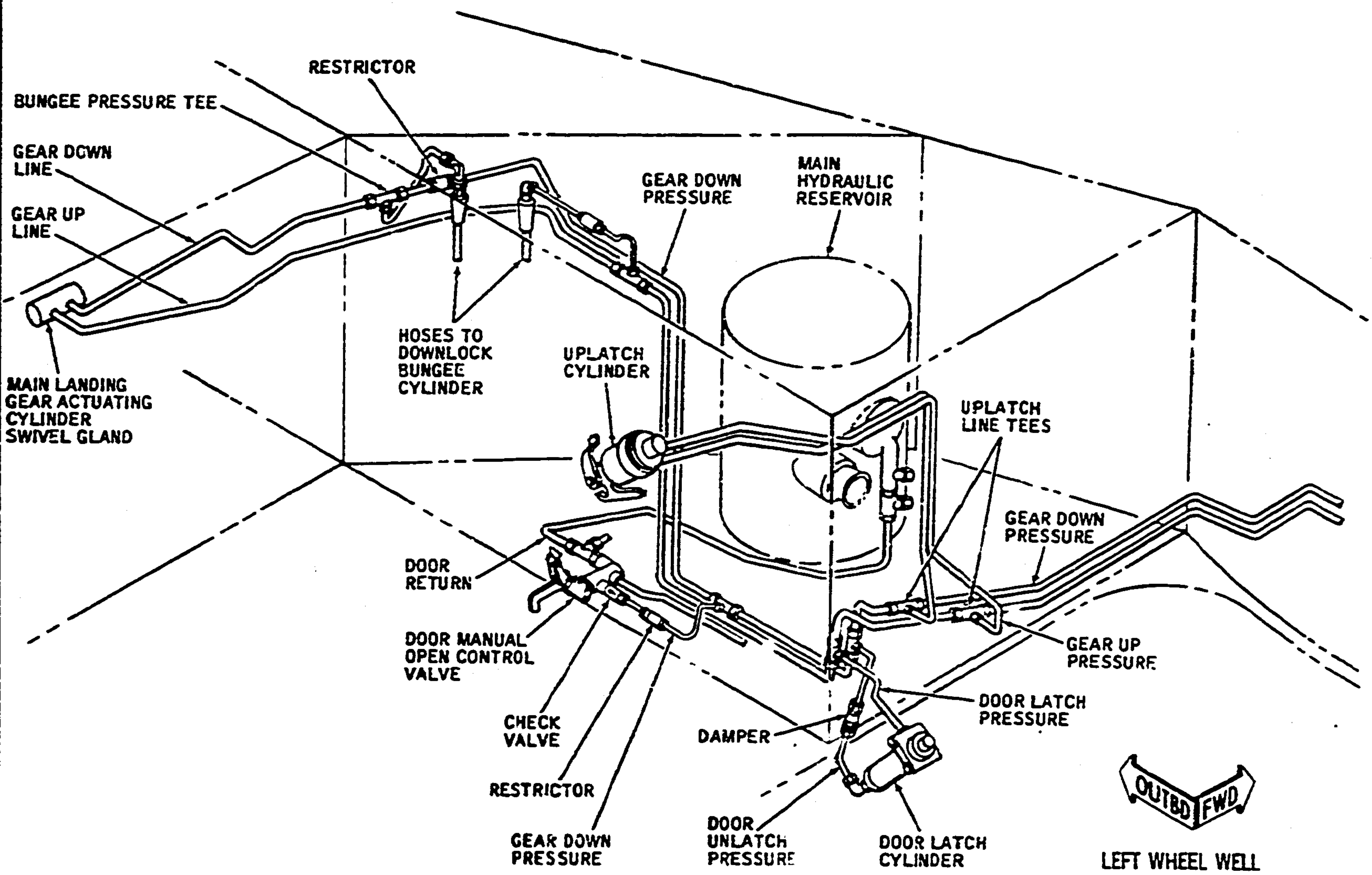
(12) Disconnect gear up and gear down lines from upstream side of actuating cylinder swivel gland. Connect jumper between these lines.

(13) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(14) Flush circuit for five minutes.



Flushing Procedure Line Connection Locations
Figure 602



Flushing Procedure Line Connection Locations
Figure 603

(15) Depressurize test stand.

(16) Inspect, clean, and/or replace actuating cylinder and attaching swivel gland, door latch assembly and attaching lines (which include damper), downlock bungee cylinder and connecting lines including 2 hoses, restrictors and several short lines.

(17) Disconnect gear uplatch lines from gear uplatch cylinder and connect jumper between lines.

(18) Connect this circuit to test stand pressure and return hoses and flush for 3 minutes. Use same pressure as in step (13).

(19) Inspect, clean, and/or replace main gear uplatch cylinder.

(20) Restore all lines and units on left side of airplane to original configuration.

(21) Connect test stand pressure hose to right gear down line, and test stand return hose to right gear up line. These lines were capped in step (5).

(22) Repeat steps (6 through 20) for right side of airplane.

(23) Make any necessary adjustments per Chapter 32.

D. Main Gear Door System

(1) Disconnect right main gear door lines from bulkhead tees in center web of airplane. Cap tees.

(2) Disconnect pressure and return lines from left door actuating cylinder swivel gland. Place jumper across these lines.

(3) Disconnect door return line from inboard side of door manual open valve. Connect line to test stand return hose.

(4) Disconnect door pressure line from main gear control valve. Connect line to test stand pressure hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for three minutes.

(7) Depressurize test stand.

(8) Disconnect pressure and return lines from right door actuating cylinder swivel gland. Connect jumper across these lines.

(9) Connect test stand pressure and return hoses to lines that were capped in step (1).

(10) Repeat steps (5 through 7) for these lines.

(11) Inspect, clean, and/or replace both door actuating units, lines, and swivel glands.

(12) Inspect, clean, and/or replace door manual open valve, short line between manual open valve and tee in down line (this line includes restrictor and check valve), and line which runs from tee in manual open valve to reservoir fitting.

(13) Restore all lines and units to original configuration, and make any necessary adjustments per Chapter 32.

E. Bogie Trim and Bogie Swivel Unlock Systems (See Figure 604.)

(1) Disconnect both bogie unlock lines, and bogie trim pressure line from bogie swivel unlock control valve located on left power manifold.

(2) Connect test stand pressure hose to bogie trim pressure line, and test stand return hose to left bogie unlock line.

(3) Disconnect bogie trim pressure line, which leads to right gear, at tee located below left power manifold and to left of airplane centerline. Cap tee.

(4) Disconnect line, which runs from tee in bogie relief valve to tee in bogie trim pressure line, at bogie trim pressure line. Cap tee.

(5) Disconnect line with check valve, which runs from tee in bogie relief valve to tee in bogie unlock line, at tee. Cap tee.

(6) Install jumper lines around main gear swivel gland in bogie trim pressure line and bogie unlock line.

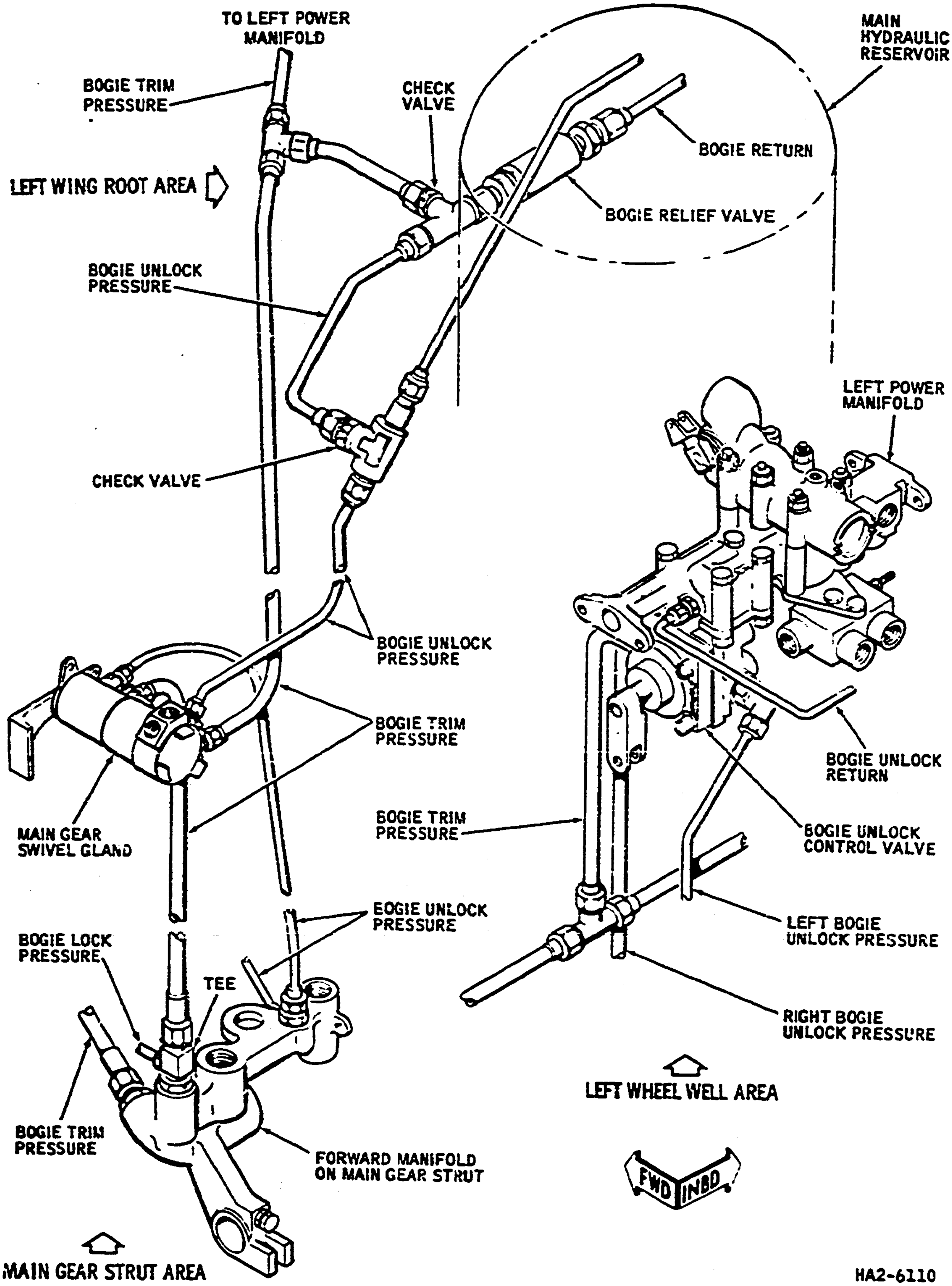
(7) Disconnect bogie trim pressure hose from manifold port below tee in forward manifold, located on shock strut above bogie beam. Cap manifold port.

(8) Disconnect both hoses from bogie unlock cylinder, and jumper these hoses together.

(9) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(10) Flush circuit for five minutes.

(11) Depressurize test stand.



Flushing Procedure Line Connection Locations
Figure 604

(12) Inspect, clean, and/or replace bogie swivel unlock valve, bogie relief valve and check valve, short lines which lead to tees in bogie trim pressure line, bogie unlock line, manual door open valve on left side of airplane, and tee in antiskid valve on right side of airplane.

(13) Inspect, clean, and/or replace swivel gland, located at top of main gear strut, bogie swivel unlock cylinder, and bogie trim cylinder with attaching hose and line.

(14) Connect right bogie trim pressure line to tee from which it was disconnected in step (3). Disconnect left bogie trim pressure line from this tee, and cap tee.

(15) Disconnect test stand return hose from left bogie unlock line and connect it to right bogie unlock line.

(16) Repeat steps (4 through 13) for right side of airplane.

(17) Restore all lines, hoses, and units to original configuration. Make adjustments as necessary per Chapter 32.

F. Nose Gear System (See Figures 605 and 606.)

(1) Disconnect nose gear down line from tee in nose gear control valve. Connect line to test stand pressure hose.

(2) Disconnect actuating cylinder gear down hose from tee in gear down line, located on left side of nosewheel well. Cap tee.

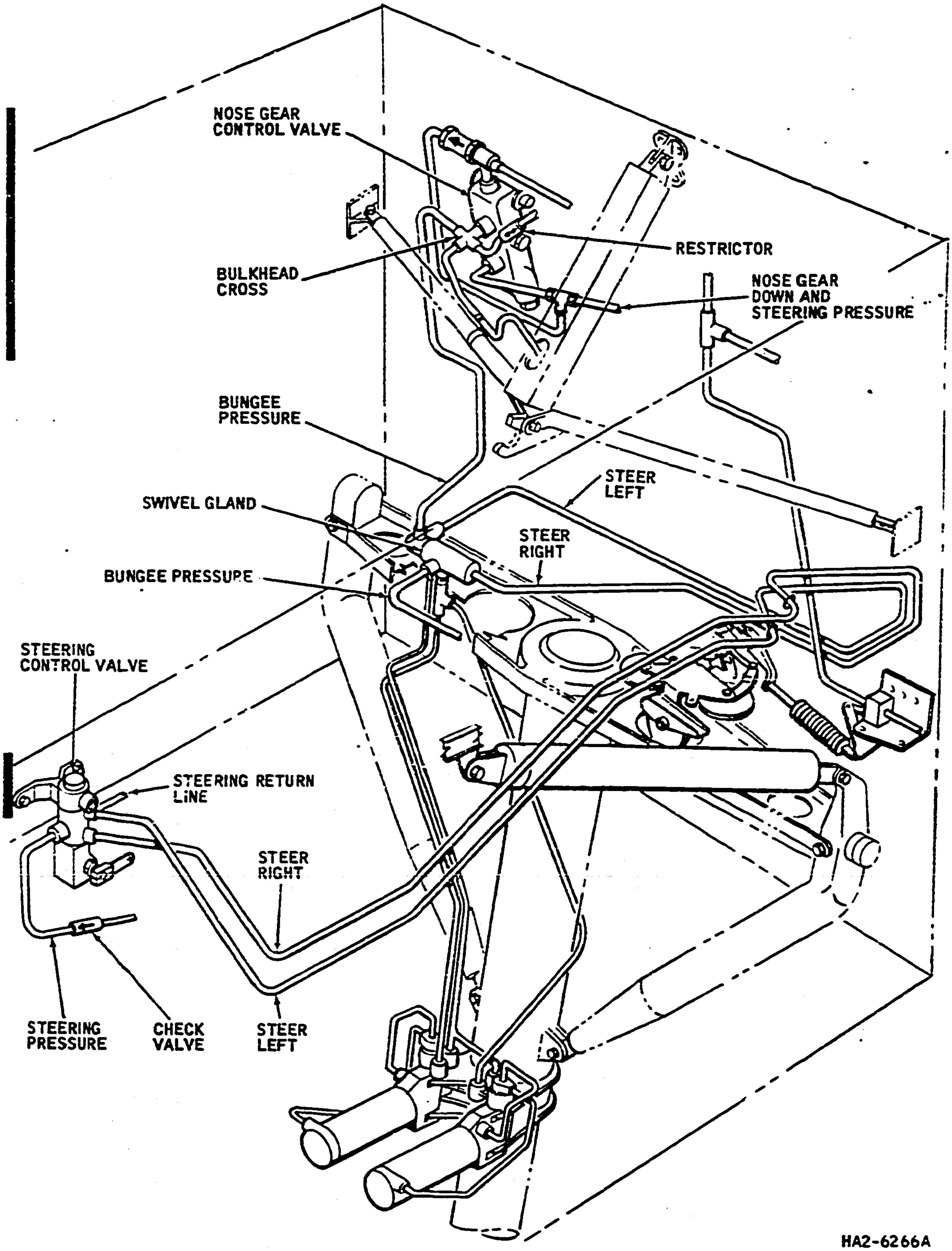
(3) Jumper check valve in steering pressure line, which runs from tee for actuating cylinder down hose to tee which branches to reserve accumulator shutoff valve and pressure line running forward.

(4) At tee between check valve, removed in step (3), and reserve accumulator shutoff valve, disconnect steering pressure line which leads forward. Cap tee.

(5) Disconnect pressure line from left side of reserve accumulator shutoff valve. Place jumper between this line and line which was disconnected in step (4).

(6) Replace check valve in steering pressure line, located aft of nosewheel steering valve, with jumper.

(7) Disconnect all four lines from steering control valve. Place jumpers between pressure line and steer right line, and between return line and steer left line.



Flushing Procedure Line Connection Locations
Figure 605

(8) Disconnect three 1/2-inch lines, and two 3/8-inch lines from swivel gland located on cross arm. Place jumper across two open steer left lines, located on opposite sides of swivel gland. Place jumper across two steer right lines, which were disconnected from same tee in swivel gland.

(9) Disconnect at steering cylinder glands, three steering lines which run from swivel gland on crossarm to glands at steering cylinders.

(10) Install jumper across two lines on right cylinder. On left cylinder install jumper from open line to open steer-right line upstream of swivel gland on crossarm.

(11) Disconnect steering return line from lower side of tee in steering relief valve. Disconnect gear actuating cylinder up hose at cylinder. Place jumper between this open line and hose.

(12) Disconnect 1/4-inch up line from restrictor on side away from control valve. Disconnect 1/4-inch bungee line at bulkhead cross fitting at control valve. Place jumper across these two open lines.

(13) Disconnect bungee line from top of swivel gland and connect to test stand return hose.

(14) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(15) Flush circuit for five minutes.

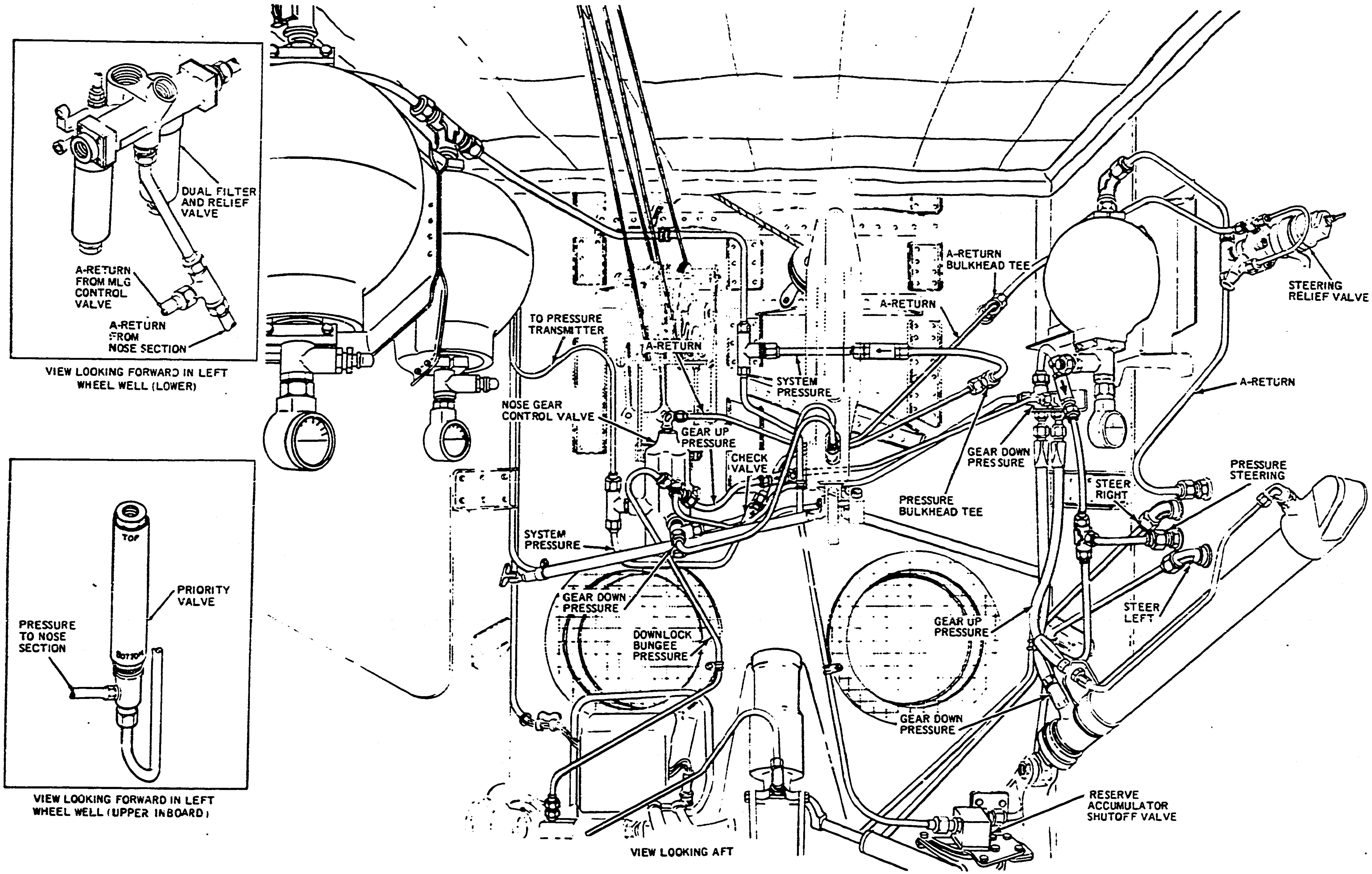
(16) Depressurize test stand.

(17) Inspect, clean, and/or replace relief valve, bleeder valve, return accumulator and two associated lines, nose gear actuating cylinder and attaching hoses, bungee cylinder and attaching line, swivel gland mounted on crossarm, uplatch cylinder and two lines which connect it to control valve.

(18) Inspect, clean, and/or replace nosewheel steering valve, located on outboard side of left side of wheel well.

(19) Inspect, clean, and/or replace nosewheel steering cylinders, restrictors, and gland assemblies and associated lines, nosewheel steering control valve, reserve accumulator shutoff valve and associated lines, and check valves.

(20) Restore all lines and units to original configuration, and make any necessary adjustments as described in Chapter 32.



Flushing Procedure Line Connection Locations
Figure 606

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G. Wheel Brake System Pressure Lines

(1) Disconnect right gear brake pressure line from brake control valve, and connect test stand pressure hose to this line (see Figure 607).

(2) Disconnect two brake pressure lines from swivel gland at top of main landing gear strut. Connect these lines with a jumper line.

(3) Disconnect brake pressure line from upstream side of tee fitting at dual servo valves.

(4) Disconnect four brake pressure outlet lines from servo valves. Connect jumper line between pressure inlet line and one pressure outlet line. Cap other three outlet lines.

(5) Disconnect inlet and outlet lines and jumper fluid quantity limiter (or lockout cylinder) in outlet line connected in step (4).

(6) Disconnect brake hose from corresponding brake, and connect hose to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) Disconnect jumper line from outlet line connected in step (4), cap outlet line, and connect jumper to one of other three outlet lines.

(11) Repeat steps (5 through 10) to flush remaining servo valve outlet lines.

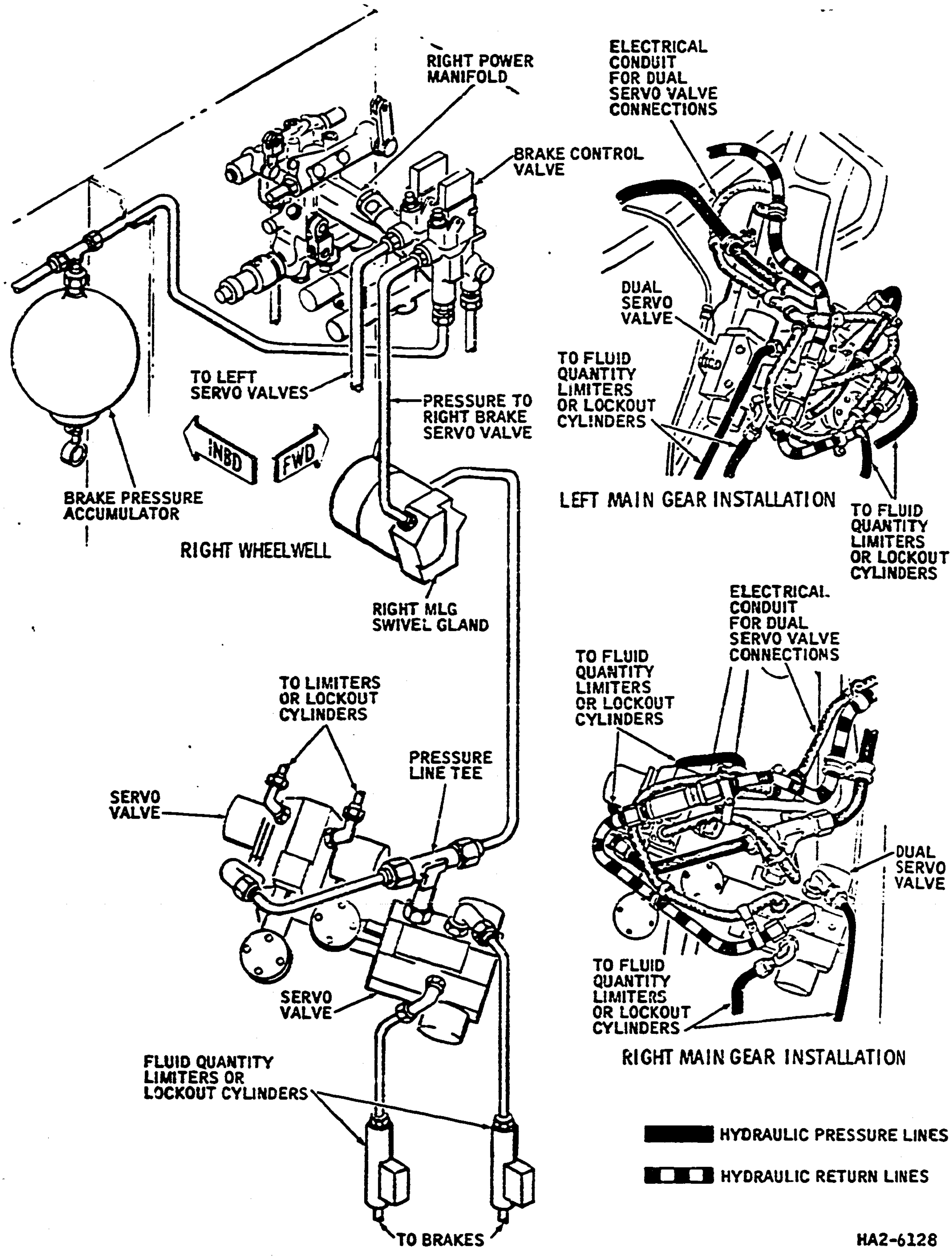
(12) Inspect, clean and/or replace brake control valve, main landing gear swivel gland, dual servo valves, fluid quantity limiters (or lockout cylinders).

(13) Disconnect test stand pressure hose from right gear brake pressure line at control valve, and connect to left gear brake pressure line at left brake control valve.

(14) Repeat steps (2 through 12) to flush left brake system pressure lines.

(15) Restore all lines and units to original configuration.

(16) To flush brake accumulators and check valve system, disconnect pressure line which runs from right power manifold to tee on accumulator. Connect test stand return hose to line that was disconnected at accumulator tee.



Flushing Procedure Line Connection Locations
Figure 607 (Sheet 1)

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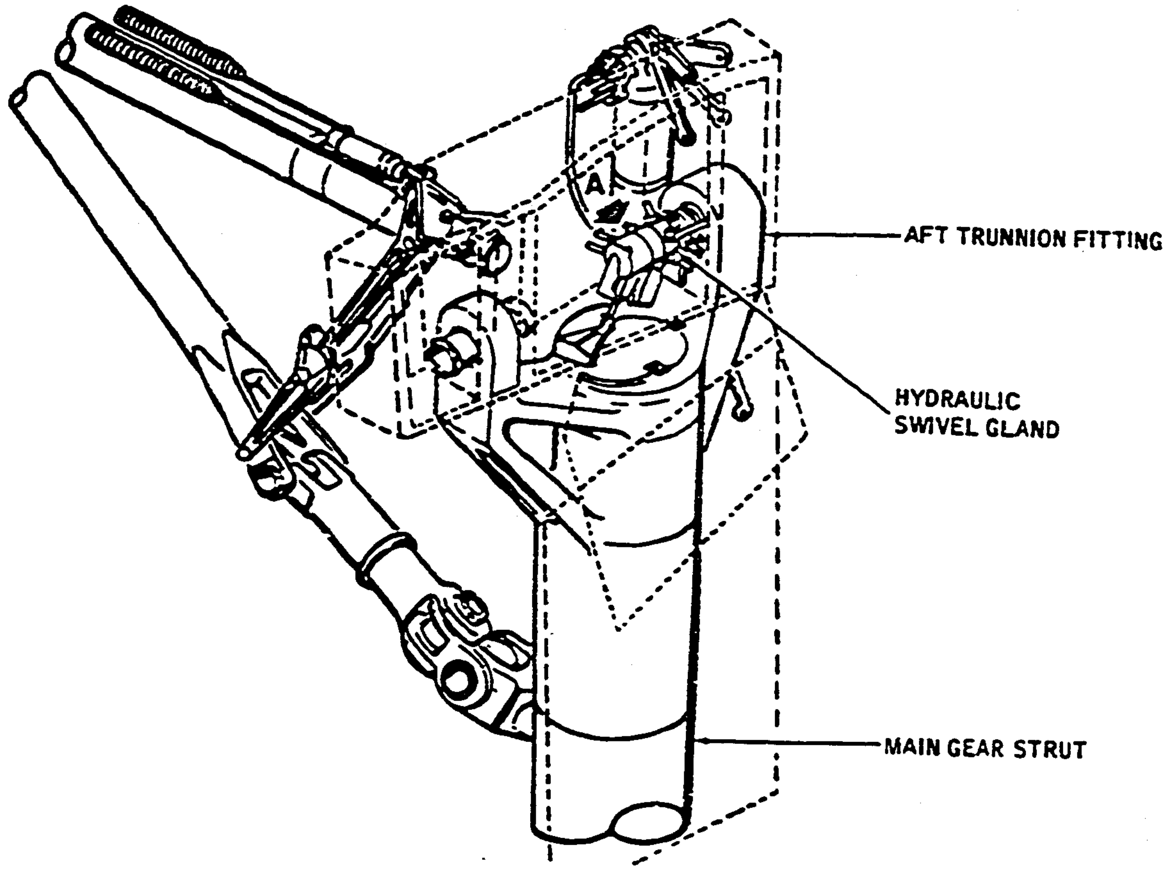
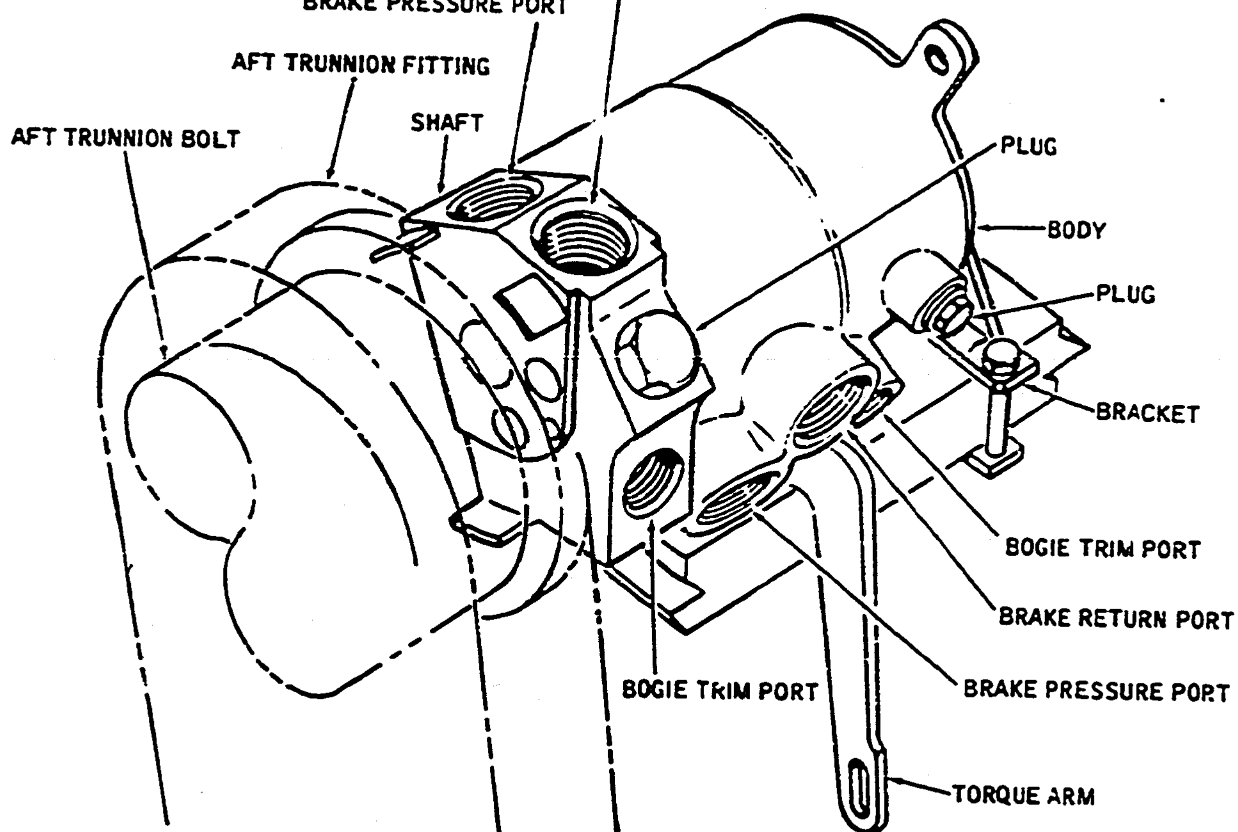




VIEW A

HA2-4287A

Flushing Procedure Line Connection Locations
Figure 607 (Sheet 2)

(17) Remove brake inlet check valve seat, spring, and poppet from right power manifold. Install seat only with seals.

(18) Remove pressure line from tee at bottom of priority valve, located below left power manifold, and connect this line to test stand pressure hose.

(19) Pressurize test stand to 200 psi at 5 to 20 gpm flow.

(20) Flush circuit for five minutes.

(21) Depressurize test stand.

(22) Remove inlet check valve seat. Examine check valve assembly for evidence of improper seating and magnetization. Install new check valve assembly if required.

(23) Remove accumulators and connecting line. Clean and flush on bench.

(24) Restore all lines and units to original configuration. Bleed and adjust brake system per Chapter 32.

H. Wheel Brake System Return Lines

(1) Disconnect right anti-skid servo valve return line at tee fitting on upper servo valve on right main gear strut. Connect test stand pressure hose to this line.

(2) Disconnect two return lines from swivel gland at top of main gear strut. Connect these lines with jumper line.

(3) Disconnect anti-skid return line from tee fitting in aileron A return line, located in right wing root area (see Figure 6C7). Cap A-return tee fitting.

(4) Disconnect bogie relief valve at tee and cap line.

(5) Connect test stand return hose to anti-skid line at tee disconnected in step (3).

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Restore all lines and units to original configuration.

(10) Disconnect left anti-skid servo valve return line at tee fitting on upper servo valve on left main gear strut. Connect test stand pressure hose to this line.

(11) Disconnect two return lines from swivel gland at top of main gear strut. Connect these lines with jumper line.

(12) Disconnect left bogie relief valve from anti-skid return line at tee fitting. Cap line and tee.

(13) Disconnect left anti-skid return line from cross fitting in case drain return port of main reservoir. Cap cross fitting.

(14) Connect test stand return hose to this line.

(15) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(16) Flush circuit for five minutes.

(17) Depressurize test stand.

(18) Restore all lines and units to original configuration.

UTILITY SYSTEMS UPSTREAM OF CONTROL SYSTEM FILTERS - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the utility systems upstream of the control system filters by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Utility Systems Upstream of Control System Filters

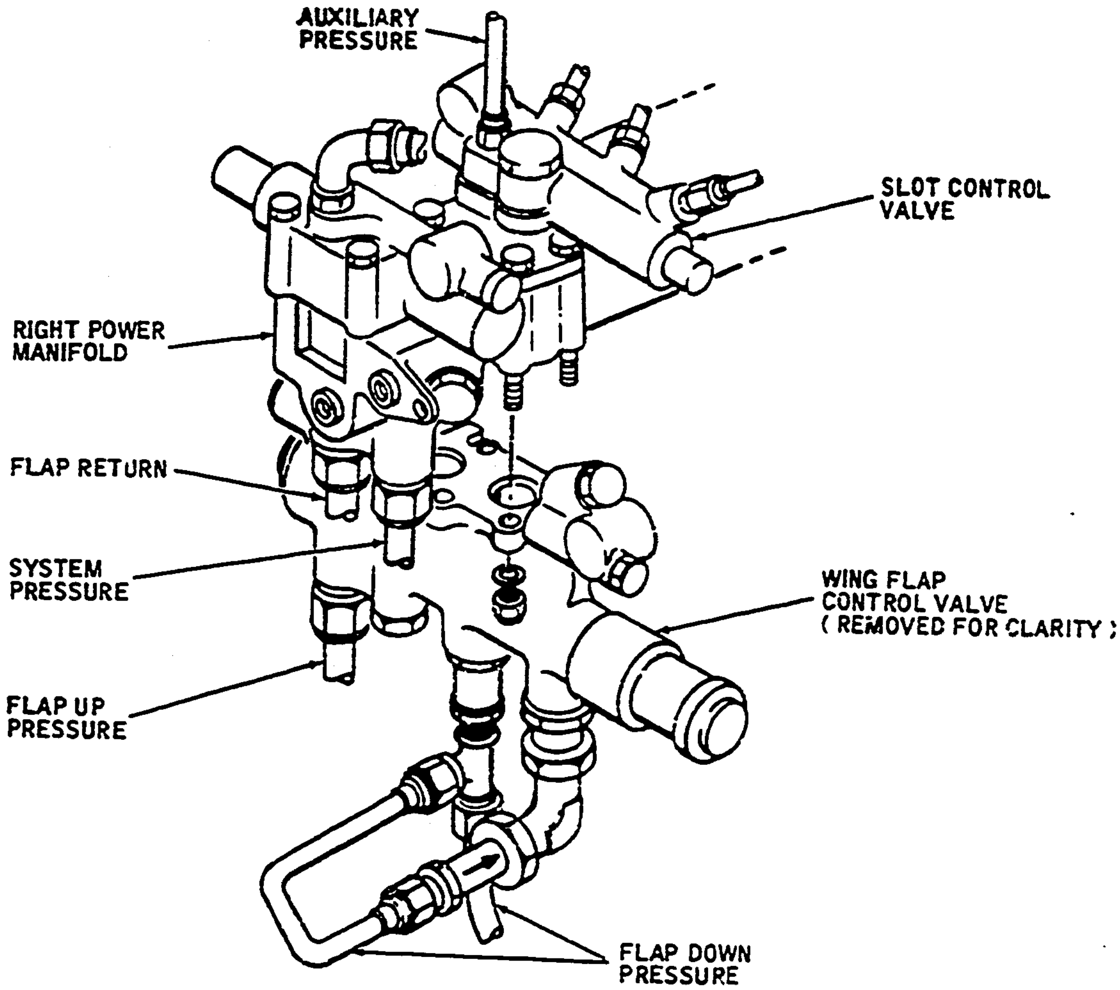
A. Wing Flap System

(1) Disconnect flap up and flap down lines from wing flap control valve (see Figure 601).

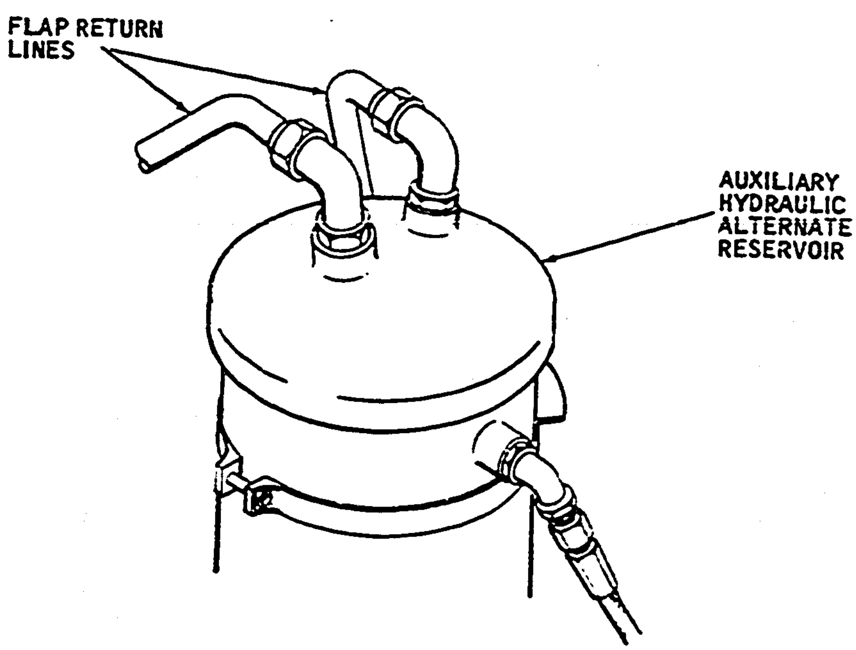
(2) Remove restrictor with portion of wing flap up line, which is connected to wing flap control valve.

(3) Disconnect flap return line from right power manifold just inboard of flap control valve. Jumper this line to flap down line, which was disconnected in step (1).

(4) Connect open flap up line to test stand pressure hose.



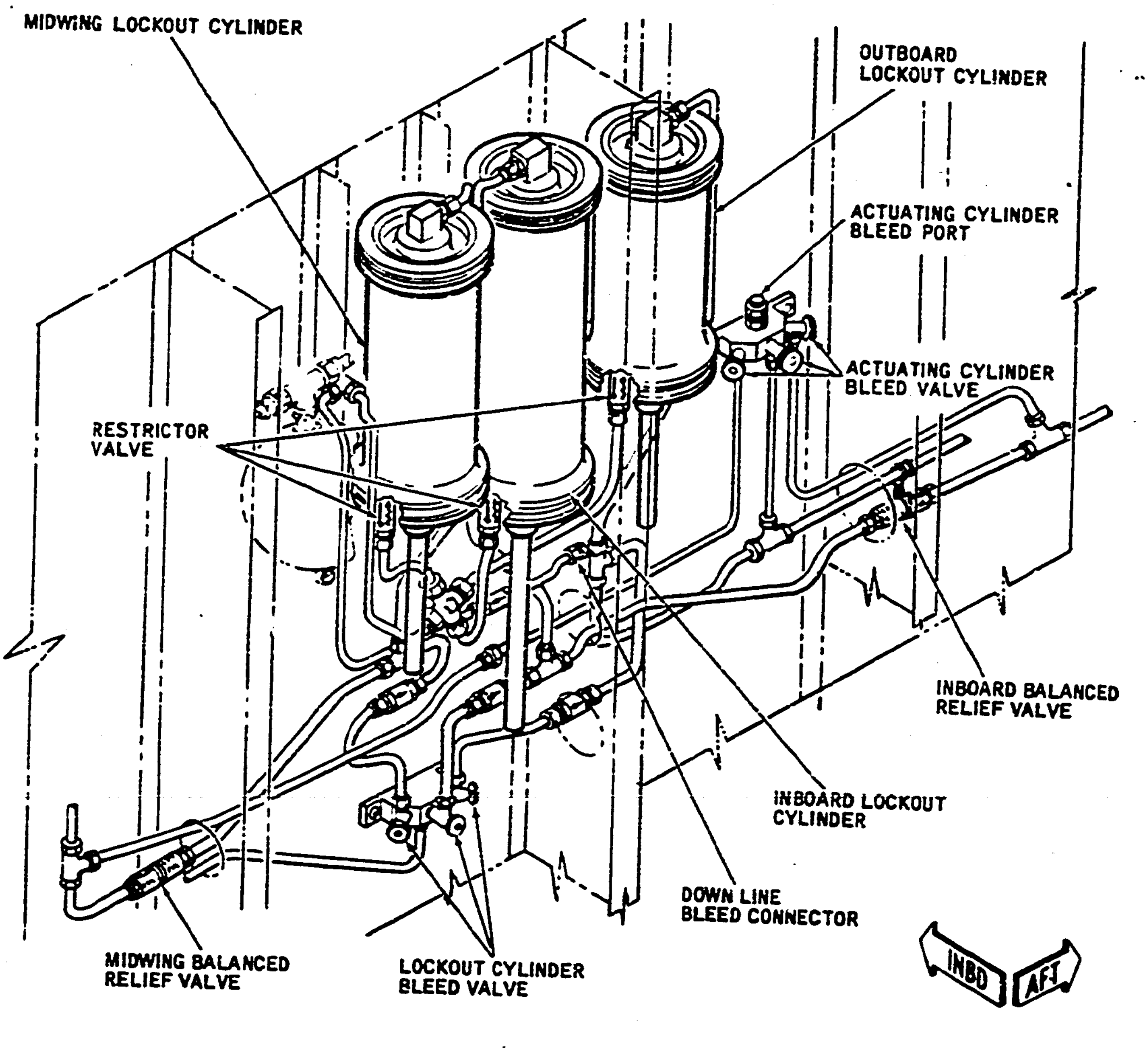
RIGHT POWER MANIFOLD



ALTERNATE RESERVOIR

HA2-6108A

Flushing Procedure Line Connection Locations
Figure 601



LEFT MAIN LANDING
GEAR WHEEL WELL

HA2-7558

Flushing Procedures -- Line Connection Location
Figure 601A

(5) Disconnect flap return line from inlet port of auxiliary pump alternate reservoir. Connect this line to test stand return hose.

(6) Remove thermal relief valve from tee in flap up line, located at STA X_{rs} = 70 in right wing root. Cap tee.

(7) Disconnect hoses from outboard flap actuating cylinders. Plug all hoses.

(8) At inboard and midwing flap actuating cylinders, disconnect flap up and flap down pressure lines and install jumper between both set of lines.

(9) Disconnect bottom line from flap lockout cylinder bleed valve manifold (see Figure 601A).

(10) Remove lines and check valves (3) from top of bleed valve manifold.

(11) Connect jumper between line disconnected in step (9) and tee fitting below inboard lockout cylinder from which check valve was removed in step (10).

(12) Disconnect lines (3) from bottom of actuating cylinder bleed valve manifold.

(13) Connect jumper between bleed line for inboard actuating cylinder and down line bleed connector.

(14) Disconnect lines from top and bottom of inboard flap lockout cylinder and connect jumper between lines.

(15) At inboard and midwing balanced relief valve, disconnect and jumper lines.

(16) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(17) Shut off pressure source.

(18) Disconnect jumper from tee fitting below inboard lockout cylinder and connect to line below midwing lockout cylinder from which check valve was removed in step (10).

(19) Disconnect jumper from bleed line for inboard actuating cylinder and connect to bleed line for midwing actuating cylinder.

(20) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(21) Disconnect lines from top and bottom of inboard flap lockout cylinder and connect jumper between lines.

(22) Disconnect jumper from line below midwing lockout cylinder and connect to line below outboard lockout cylinder from which check valve was removed in step (10).

(23) Disconnect jumper from bleed line for midwing actuating cylinder and connect to bleed line for outboard actuating cylinder.

(24) At midwing flap actuating cylinders, remove jumpers. Plug flap down pressure lines.

(25) Connect jumper between midwing actuating cylinder up pressure line and outboard actuating cylinder down pressure lines.

(26) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(27) Shut off pressure source.

(28) Disconnect test stand pressure hose from flap up line. Connect line to wing flap control valve.

(29) Disconnect auxiliary pump case drain line from inlet port on side of alternate reservoir and from case drain of auxiliary pump.

(30) Connect test stand pressure hose and return hose to drain line, flush for three minutes.

(31) Disconnect auxiliary pump suction line at alternate reservoir and auxiliary pump selector valve.

(32) Disconnect test stand pressure hose and test stand return hose from auxiliary pump case drain line, and connect to auxiliary pump suction line, flush for three minutes.

(33) Remove jumpers at all flap actuating cylinders, flap lockout cylinders, flap control valve, and actuating cylinder bleed valve manifold. Connect airplane lines to applicable component.

(34) Bench flush short lines that run between lockout cylinder bleed valve manifold and check valve (removed in step 10).

(35) Install lines and check valves on lockout cylinder bleed valve manifold.

(36) Remove and bench flush short line that runs between thermal relief valve and tee in low-pressure return line.

NOTE: Steps (37) through (47) have been deleted.

(47) Remove and bench flush short line that runs between thermal relief valve and tee in low-pressure return line.

(48) Inspect, clean, and/or replace all flap actuator cylinders, lockout cylinders, thermal relief valve, balanced relief valves, restrictor valve, and flap control valve.

(49) Restore all lines and units to original configuration.

(50) Adjust rigging if necessary (see Chapter 27).

B. Wing Slot System

(1) Disconnect slots open and slots closed lines from wing slot control valve, located on right power manifold (see Figure 601).

(2) Connect slots open line to test stand pressure hose. Connect slots closed line to test stand return hose.

(3) Disconnect lines from 4 slot cylinders, cap all lines except outboard right cylinder lines. Install jumper across these two lines.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for three minutes.

(6) Depressurize test stand.

(7) Move jumper to right inboard slot cylinder lines, cap outboard lines, and repeat steps (4 through 6).

(8) Repeat steps (3 through 7) for left side. Make certain that all lines on both sides of airplane, with exception of jumpered lines, are capped.

(9) Inspect, clean, and/or replace wing slot cylinders and wing slot control valve, located on right power manifold.

(10) Restore all lines and units to original configuration. Adjust rigging if necessary per Chapter 27.

C. Main Gear Retract System (See Figures 602 and 603.)

(1) Disconnect gear up pressure line, gear down pressure line, and gear down return lines from main gear control valve.

(2) Connect jumper between gear down pressure line and gear down A-return line.

(3) Connect gear up line to test stand pressure hose.

(4) Disconnect gear down A-return line from tee in (nose gear return) A-return line, located in left wheel well aft of rear spar and below dual filter and relief valve. Connect line to test stand return hose.

(5) Disconnect right gear up and gear down lines from tees, located to right of centerline of airplane. Cap tees. Left gear retract system will be flushed first.

(6) In left wheel well, disconnect both main gear uplatch lines from tees in gear up and gear down lines. Cap tees.

(7) Disconnect both main gear door latch lines from tees in gear up and gear down lines near wing root. Cap tees.

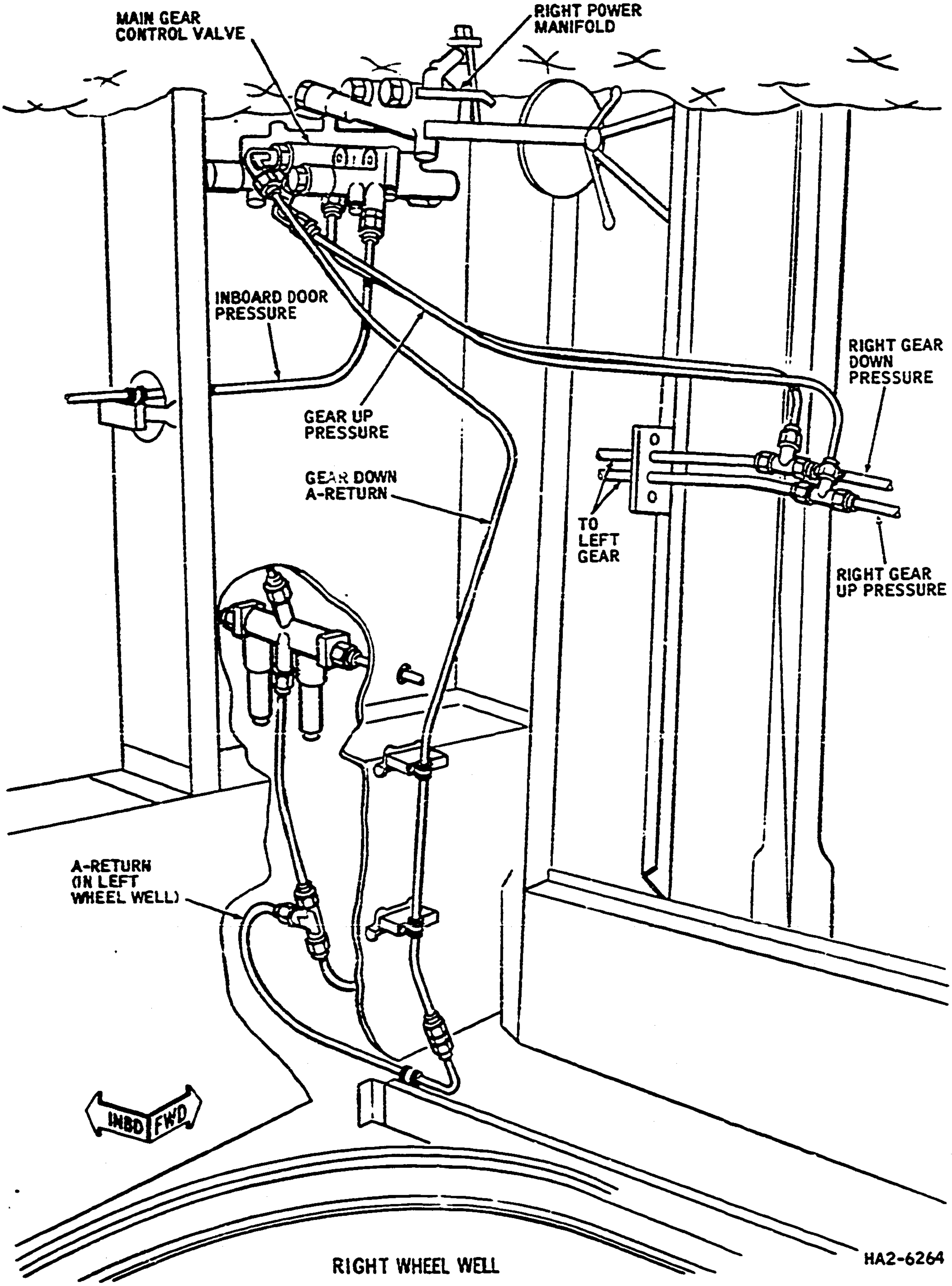
(8) Disconnect downlock bungee pressure line from tee in gear up line. Cap tee.

(9) Disconnect line, which leads to bungee cylinder, from tee in gear down line. Cap tee.

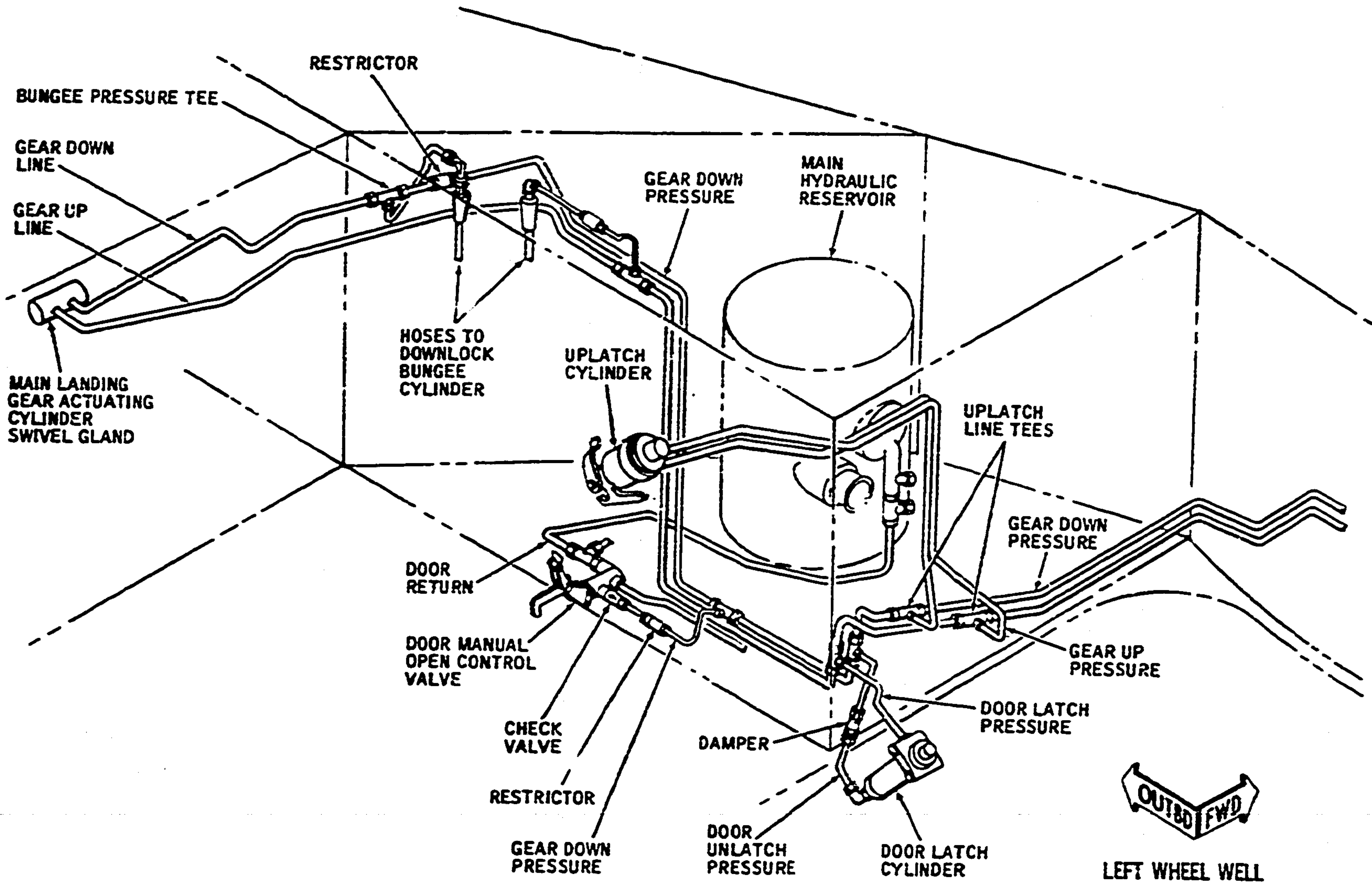
(10) Disconnect line, which leads to gear door manual open valve, from tee in main gear down line. Cap tee.

(11) Replace restrictor in gear down line with jumper.

(12) Disconnect gear up and gear down lines from upstream side of actuating cylinder swivel gland. Connect jumper between these lines.



Flushing Procedure Line Connection Locations
Figure 602



Flushing Procedure Line Connection Locations
Figure 603

(13) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(14) Flush circuit for five minutes.

(15) Depressurize test stand.

(16) Inspect, clean, and/or replace actuating cylinder and attaching swivel gland, door latch assembly and attaching lines (which include damper), downlock bungee cylinder and connecting lines including 2 hoses, restrictors and several short lines.

(17) Disconnect gear uplatch lines from gear uplatch cylinder and connect jumper between lines.

(18) Connect this circuit to test stand pressure and return hoses and flush for 3 minutes. Use same pressure as in step (13).

(19) Inspect, clean, and/or replace main gear uplatch cylinder.

(20) Restore all lines and units on left side of airplane to original configuration.

(21) Connect test stand pressure hose to right gear down line, and test stand return hose to right gear up line. These lines were capped in step (5).

(22) Repeat steps (6 through 20) for right side of airplane.

(23) Make any necessary adjustments per Chapter 32.

D. Main Gear Door System

(1) Disconnect right main gear door lines from bulkhead tees in center web of airplane. Cap tees.

(2) Disconnect pressure and return lines from left door actuating cylinder swivel gland. Place jumper across these lines.

(3) Disconnect door return line from inboard side of door manual open valve. Connect line to test stand return hose.

(4) Disconnect door pressure line from main gear control valve. Connect line to test stand pressure hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for three minutes.

(7) Depressurize test stand.

(8) Disconnect pressure and return lines from right door actuating cylinder swivel gland. Connect jumper across these lines.

(9) Connect test stand pressure and return hoses to lines that were capped in step (1).

(10) Repeat steps (5 through 7) for these lines.

(11) Inspect, clean, and/or replace both door actuating units, lines, and swivel glands.

(12) Inspect, clean, and/or replace door manual open valve, short line between manual open valve and tee in down line (this line includes restrictor and check valve), and line which runs from tee in manual open valve to reservoir fitting.

(13) Restore all lines and units to original configuration, and make any necessary adjustments per Chapter 32.

E. Bogie Trim and Bogie Swivel Unlock Systems (See Figure 604.)

(1) Disconnect both bogie unlock lines, and bogie trim pressure line from bogie swivel unlock control valve located on left power manifold.

(2) Connect test stand pressure hose to bogie trim pressure line, and test stand return hose to left bogie unlock line.

(3) Disconnect bogie trim pressure line, which leads to right gear, at tee located below left power manifold and to left of airplane centerline. Cap tee.

(4) Disconnect line with check valve, which runs from tee in bogie relief valve to tee in bogie unlock line, at tee. Cap tee.

(5) Install jumper lines around main gear swivel gland in bogie trim pressure line and bogie unlock line.

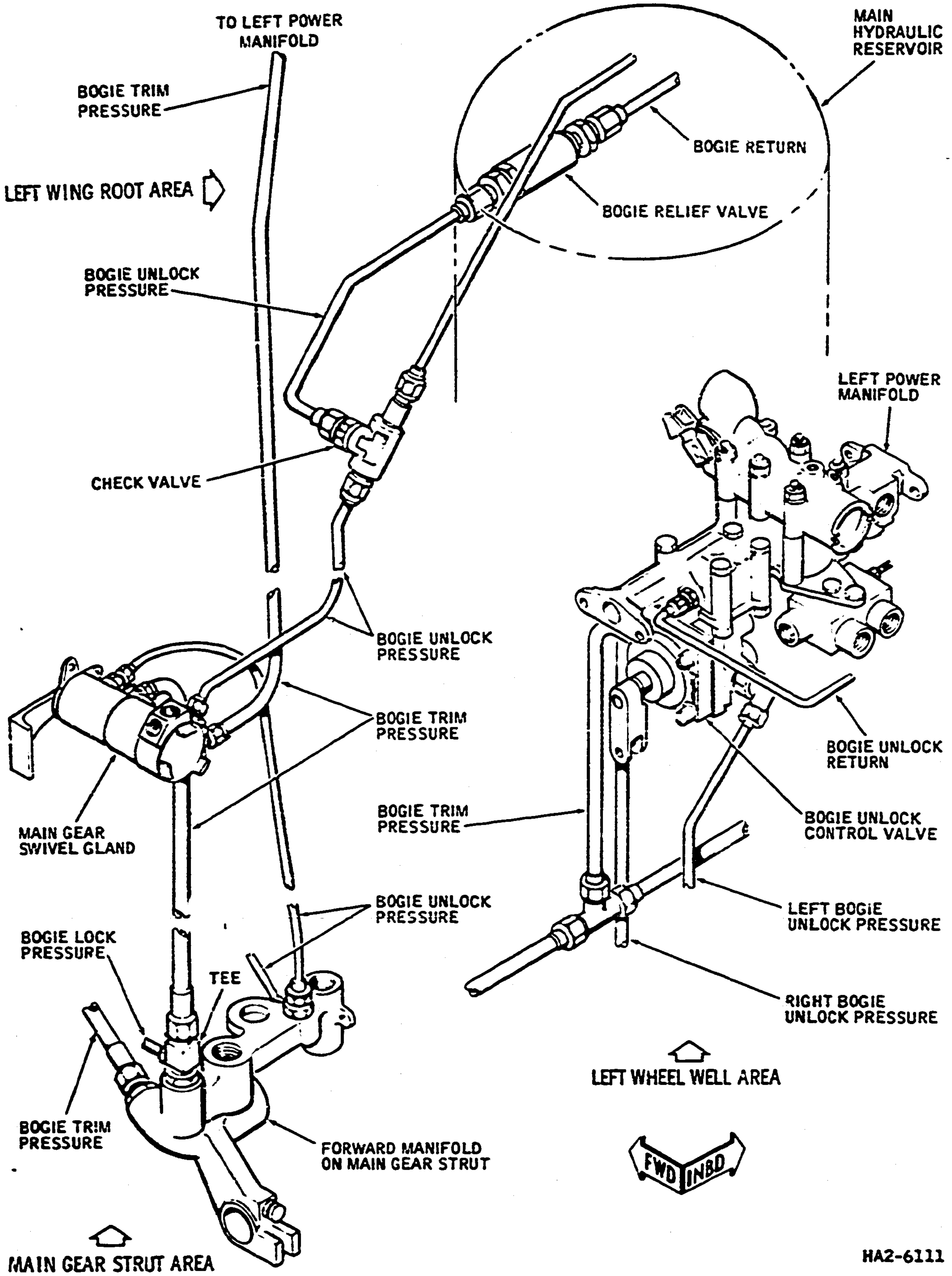
(6) Disconnect bogie trim pressure hose from manifold port below tee in forward manifold, located on shock strut above bogie beam. Cap manifold.

(7) Disconnect both hoses from bogie unlock cylinder, and jumper these hoses together.

(8) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(9) Flush circuit for five minutes.

(10) Depressurize test stand.



Flushing Procedure Line Connection Locations
Figure 604

(11) Inspect, clean, and/or replace bogie swivel unlock valve, bogie relief valve and check valve, three short lines which lead to tees in bogie trim pressure line, bogie unlock line, manual door open valve on left side of airplane, and tee in antiskid valve on right side of airplane.

(12) Inspect, clean, and/or replace swivel gland, located at top of main gear strut, bogie swivel unlock cylinder, and bogie trim cylinder with attaching hose and line.

(13) Connect right bogie trim pressure line to tee from which it was disconnected in step (3). Disconnect left bogie trim pressure line from this tee, and cap tee.

(14) Disconnect test stand return hose from left bogie unlock line and connect it to right bogie unlock line.

(15) Repeat steps (4 through 12) for right side of airplane.

(16) Restore all lines, hoses, and units to original configuration. Make adjustments as necessary per Chapter 32.

F. Nose Gear System (See Figures 605 and 606.)

(1) Disconnect nose gear down line from tee just inboard of nose gear control valve. Connect line to test stand pressure hose.

(2) Disconnect actuating cylinder gear down hose from tee in gear down line, located on left side of nosewheel well. Cap tee.

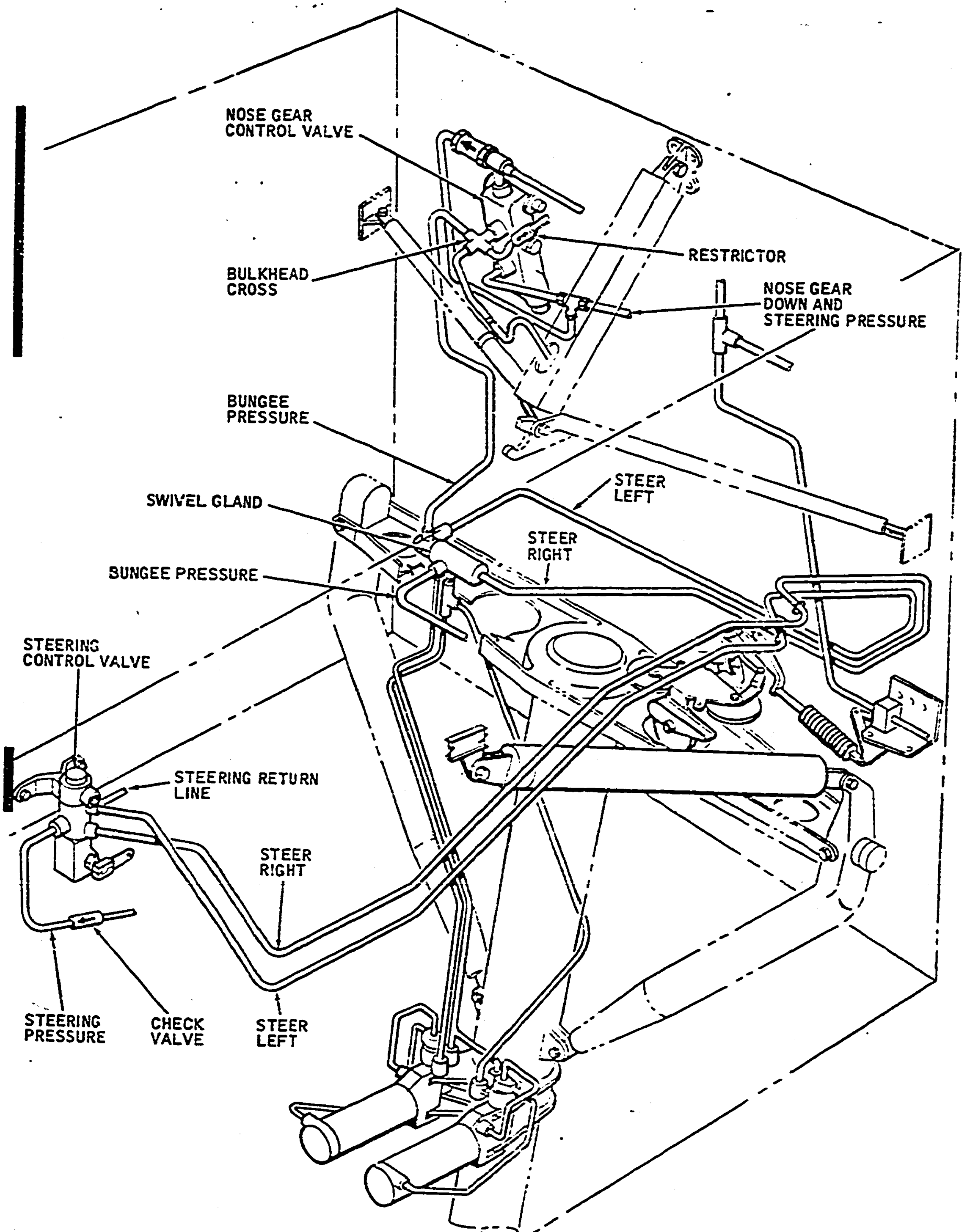
(3) Jumper check valve in steering pressure line, which runs from tee for actuating cylinder down hose to tee which branches to reserve accumulator shutoff valve and pressure line running forward.

(4) At tee between check valve, removed in step (3), and reserve accumulator shutoff valve, disconnect steering pressure line which leads forward. Cap tee.

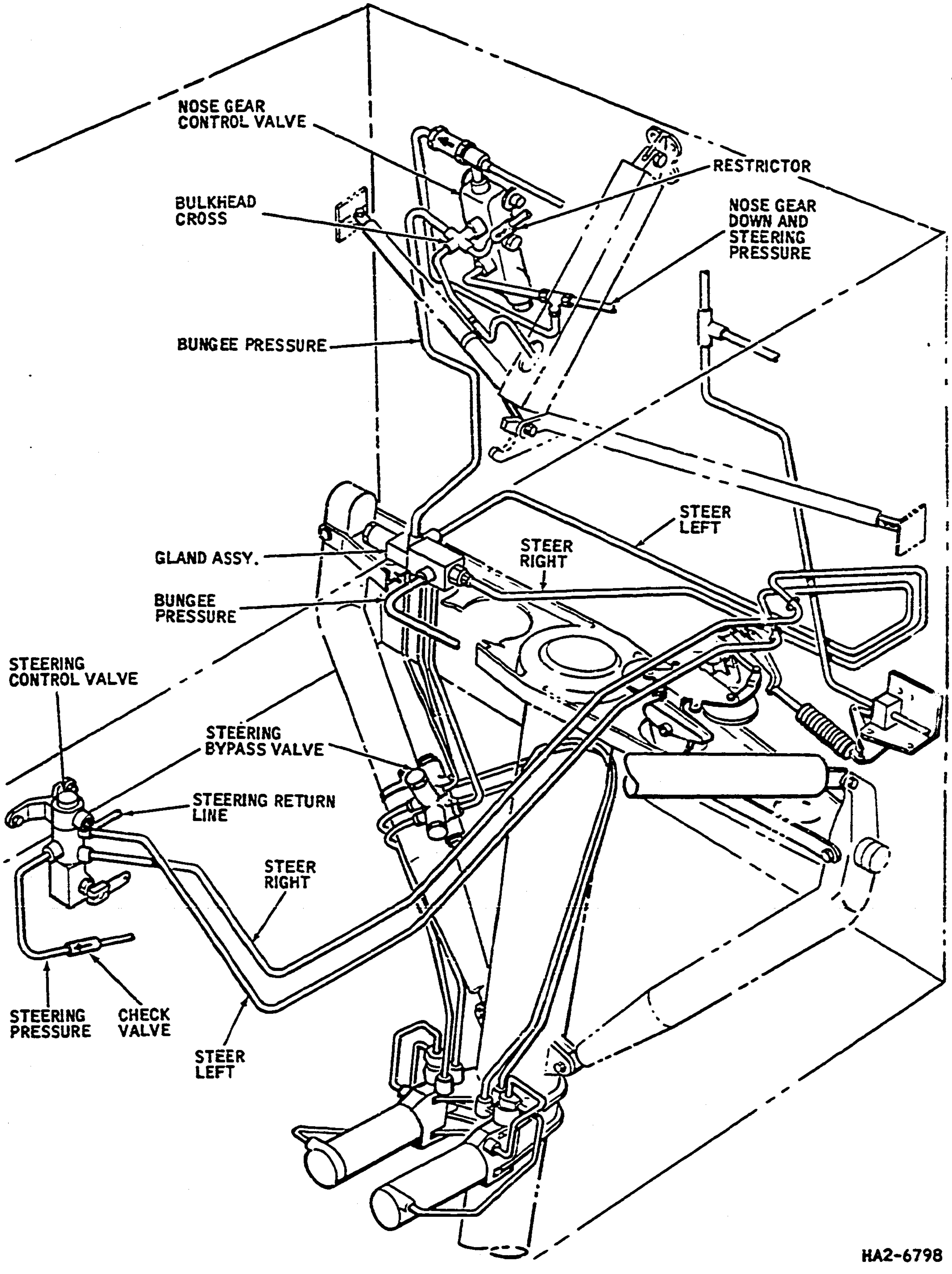
(5) Disconnect pressure line from left side of reserve accumulator shutoff valve. Place jumper between this line and line which was disconnected in step (4).

(6) Replace check valve in steering pressure line, located aft of nosewheel steering valve, with jumper.

(7) Disconnect all four lines from steering control valve. Connect jumpers between pressure line and steer right line, and between return line and steer left line.



Flushing Procedure Line Connection Locations
(Airplanes Without Steering Bypass Valve)
Figure 605



Flushing Procedure Line Connection Locations
(Airplanes With Steering Bypass Valve)
Figure 605A

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(8) On airplanes without nose gear steering bypass valve, perform steps (a) through (c).

(a) Disconnect five steering lines from swivel gland and tee located on cross arm. Connect jumper across two open steer left lines located on opposite sides of swivel gland. Connect jumper across two steer right lines which were disconnected from same tee in swivel gland.

(b) Disconnect at steering cylinder glands, three steering lines which run from swivel gland on crossarm to glands at steering cylinders.

(c) Install jumper across two lines on right cylinder. On left cylinder, install jumper from open line to open steer-right line upstream of swivel gland on crossarm.

(9) On airplanes equipped with nose gear steering bypass valve, perform steps (a) through (h).

(a) Disconnect four steering lines from swivel gland located on cross arm. Connect jumper across two open steer left lines. Connect jumper across two open steer right lines.

(b) At steering relief valve, disconnect six steering lines.

(c) Connect jumper between steer left inlet line and one of steering lines to right steering cylinder.

(d) Connect jumper between steer right inlet line and one of steering lines to left steering cylinder.

(e) Jumper remaining left cylinder line to remaining right cylinder line.

(f) Disconnect and jumper two lines at right steering cylinder swivel glands.

(g) Disconnect and jumper two lines at left steering cylinder swivel glands.

(h) Disconnect and remove for cleaning, short bypass valve return line between cross arm swivel gland and bypass valve.

(10) Disconnect steering return line from lower side of tee in steering relief valve. Disconnect gear actuating cylinder up hose at cylinder. Connect jumper between this open line and hose.

(11) Disconnect 1/4-inch up line from restrictor on side away from control valve. Disconnect 1/4-inch bungee line at bulkhead cross fitting at control valve. Connect jumper across these two open lines.

(12) On airplanes without nose gear steering bypass valve, disconnect bungee line from top of swivel gland and connect to test stand return hose.

(13) On airplanes equipped with nose gear steering bypass valve, disconnect bungee line from top of swivel gland and bypass valve return line at outboard side of swivel gland. Connect jumper between open lines. Disconnect bypass valve return line from bulkhead tee below steering relief valve and connect test stand return hose to line.

(14) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(15) Flush circuit for five minutes.

(16) Depressurize test stand.

(17) Inspect, clean, and/or replace relief valve, bleeder valve, return accumulator and two associated lines, nose gear actuating cylinder and attaching hoses, bungee cylinder and attaching line, swivel gland mounted on crossarm, uplatch cylinder and two lines which connect it to control valve.

(18) Inspect, clean, and/or replace nosewheel steering valve, located on outboard side of left side of wheel well and steering bypass valve on airplanes so equipped.

(19) Inspect, clean, and/or replace nosewheel steering cylinders, restrictors, and gland assemblies and associated lines, nosewheel steering control valve, reserve accumulator shutoff valve and associated lines, and check valves.

(20) Restore all lines and units to original configuration, and make any necessary adjustments as described in Chapter 32.

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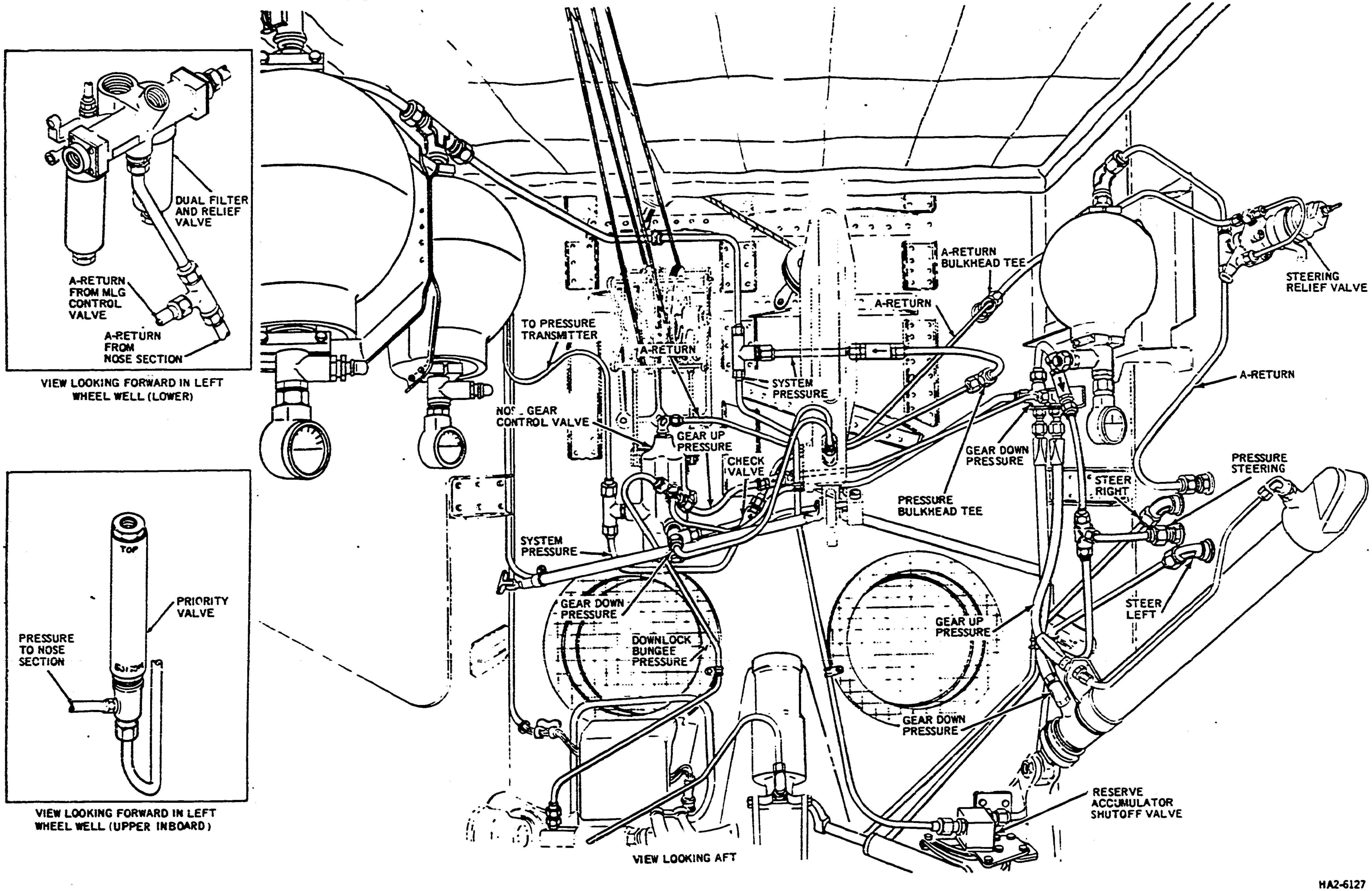


Flushing Procedure Line Connection Locations
Figure 606

G. Wheel Brake System Pressure Lines

(1) Disconnect right gear brake pressure line from brake control valve, and connect test stand pressure hose to this line (see Figure 607).

(2) Disconnect two brake pressure lines from swivel gland at top of main landing gear strut. Connect these lines with a jumper line.

(3) Disconnect brake pressure line from upstream side of tee fitting at dual servo valves.

(4) Disconnect four brake pressure outlet lines from servo valves. Connect jumper line between pressure inlet line and one pressure outlet line. Cap other three outlet lines.

(5) Disconnect inlet and outlet lines and jumper fluid quantity limiter (or lockout cylinder) in outlet line connected in step (4).

(6) Disconnect brake hose from corresponding brake, and connect hose to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) Disconnect jumper line from outlet line connected in step (4), cap outlet line, and connect jumper to one of other three outlet lines.

(11) Repeat steps (5 through 10) to flush remaining servo valve outlet lines.

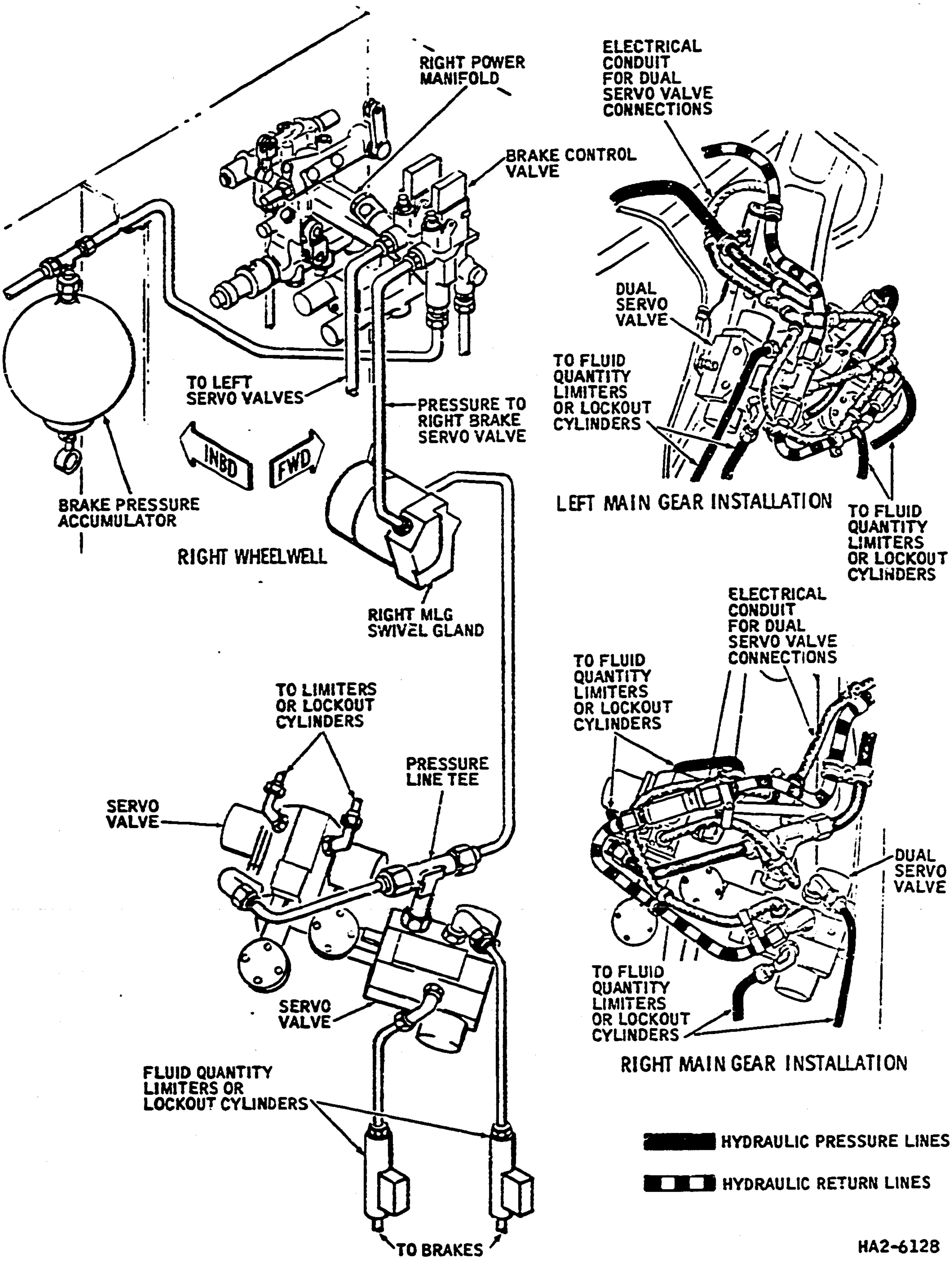
(12) Inspect, clean, and/or replace brake control valve, main landing gear swivel gland, dual servo valves, fluid quantity limiters (or lockout cylinders).

(13) Disconnect test stand pressure hose from right gear brake pressure line at control valve, and connect to left gear brake pressure line at left brake control valve.

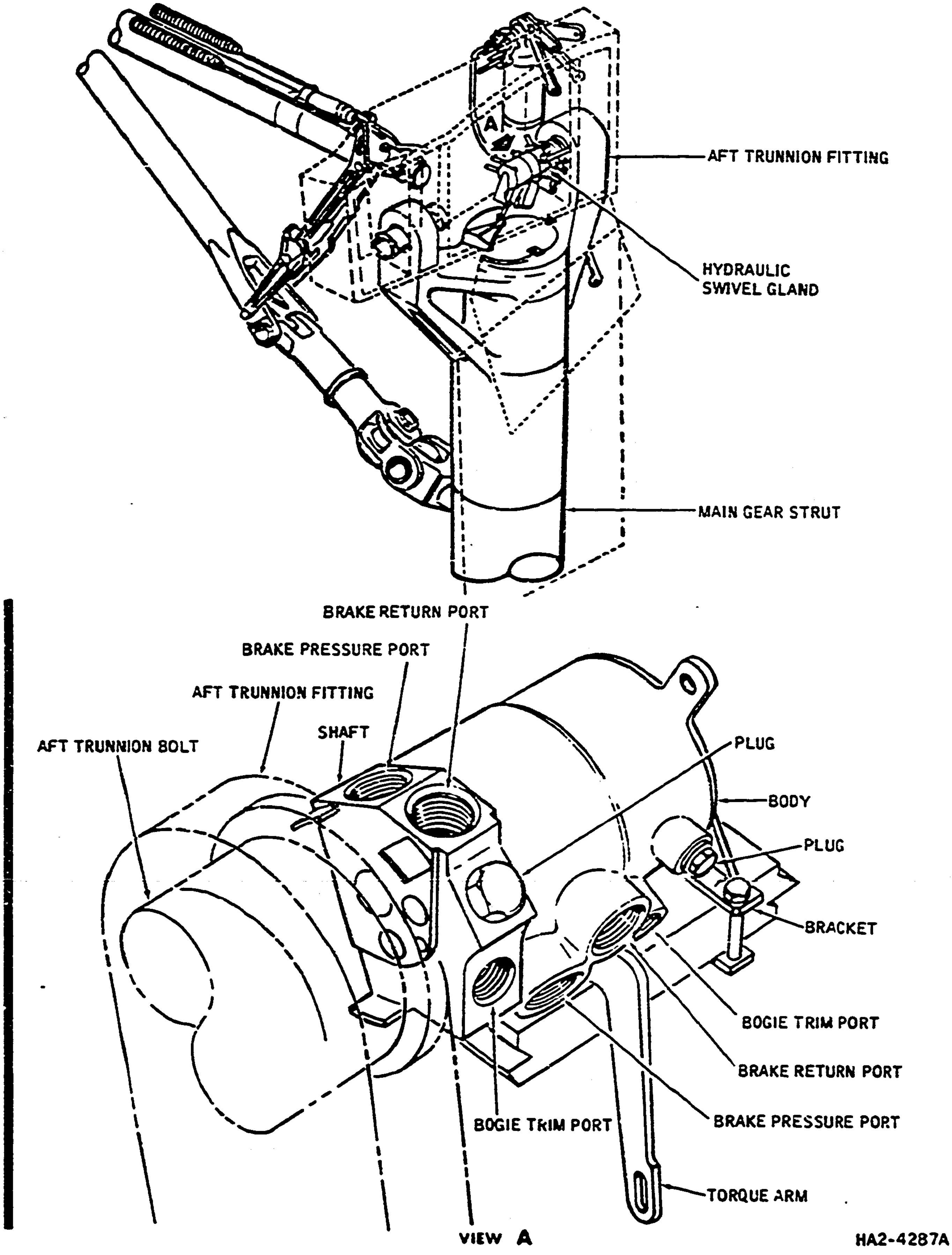
(14) Repeat steps (2 through 12) to flush left brake system pressure lines.

(15) Restore all lines and units to original configuration.

(16) To flush brake accumulators and check valve system, disconnect pressure line which runs from right power manifold to tee on accumulator. Connect test stand return hose to line that was disconnected at accumulator tee.



Flushing Procedure Line Connection Locations
Figure 607 (Sheet 1)



Flushing Procedure Line Connection Locations
Figure 607 (Sheet 2)

(17) Remove brake inlet check valve seat, spring, and poppet from right power manifold. Install seat only with seals.

(18) Remove pressure line from tee at bottom of priority valve, located below left power manifold, and connect this line to test stand pressure hose.

(19) Pressurize test stand to 200 psi at 5 to 20 gpm flow.

(20) Flush circuit for five minutes.

(21) Depressurize test stand.

(22) Remove inlet check valve seat. Examine check valve assembly for evidence of improper seating and magnetization. Install new check valve assembly if required.

(23) Remove accumulators and connecting line. Clean and flush on bench.

(24) Restore all lines and units to original configuration. Bleed and adjust brake system per Chapter 32.

H. Wheel Brake System Return Lines

(1) Disconnect right anti-skid servo valve return line at tee fitting on upper servo valve on right main gear strut. Connect test stand pressure hose to this line.

(2) Disconnect two return lines from swivel gland at top of main gear strut. Connect these lines with jumper line.

(3) Disconnect anti-skid return line from tee fitting in aileron A return line, located in right wing root area (see Figure 607). Cap A-return tee fitting.

(4) Disconnect bogie relief valve at tee and cap line.

(5) Connect test stand return hose to anti-skid line at tee disconnected in step (3).

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Restore all lines and units to original configuration.

(10) Disconnect left anti-skid servo valve return line at tee fitting on upper servo valve on left main gear strut. Connect test stand pressure hose to this line.

(11) Disconnect two return lines from swivel gland at top of main gear strut. Connect these lines with jumper line.

(12) Disconnect left bogie relief valve from anti-skid return line at tee fitting. Cap line and tee.

(13) Disconnect left anti-skid return line from cross fitting in case drain return port of main reservoir. Cap cross fitting.

(14) Connect test stand return hose to this line.

(15) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(16) Flush circuit for five minutes.

(17) Depressurize test stand.

(18) Restore all lines and units to original configuration.

UTILITY SYSTEMS UPSTREAM OF CONTROL SYSTEM FILTERS - INSPECTION/CHECK

1. General

   A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the utility systems upstream of the control system filters by flushing the systems with clean hydraulic fluid.

   B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

   C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

   D. Before any flushing procedures are performed, personnel should read and thoroughly understand 29-00, Inspection/Check.

2. Tools and Equipment Required

   A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

   B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Utility Systems Upstream of Control System Filters

   A. Wing Flap System

      (1) Disconnect flap up and flap down lines from wing flap control valve (see Figure 601).

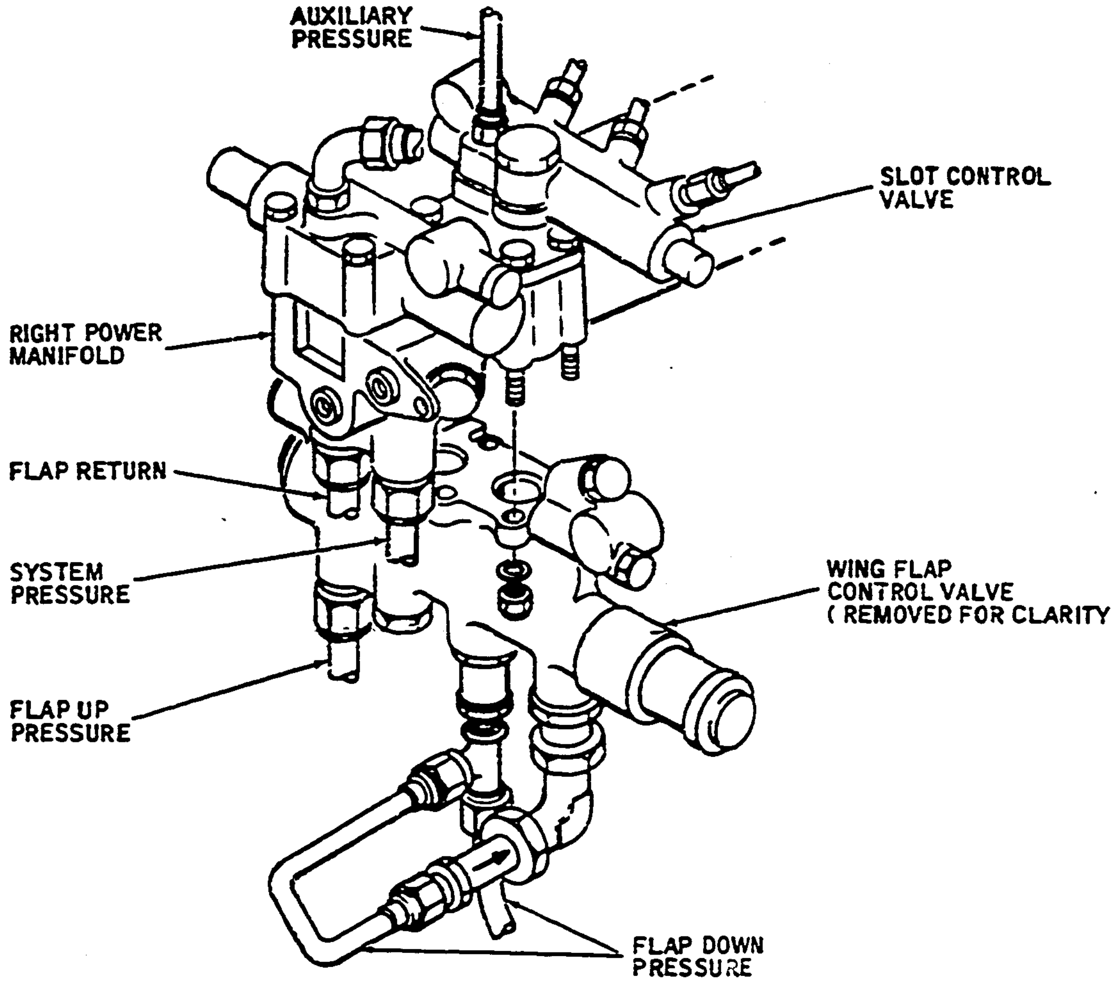
      (2) Remove restrictor with portion of wing flap up line, which is connected to wing flap control valve.

      (3) Disconnect flap return line from right power manifold just inboard of flap control valve. Jumper this line to flap down line, which was disconnected in Step (1).

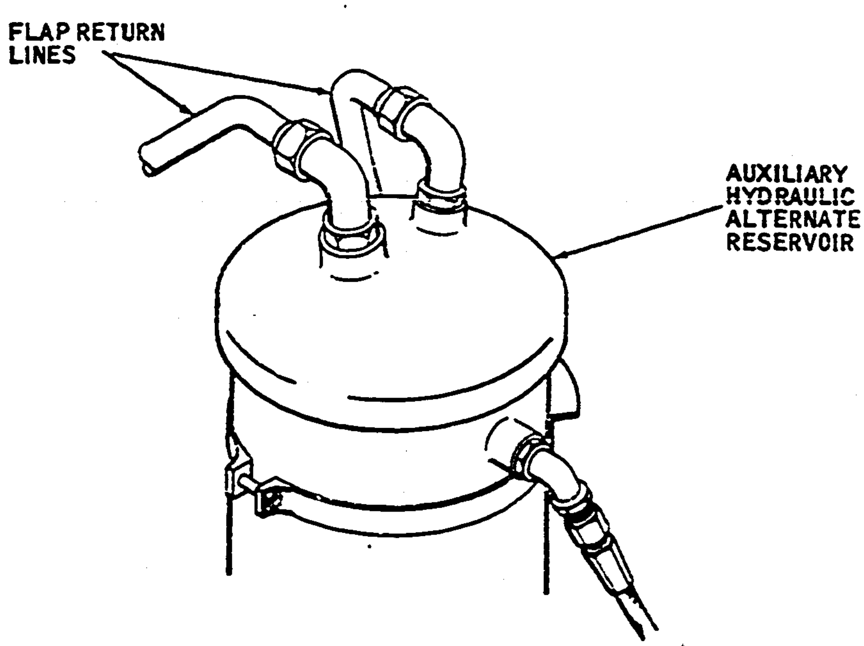
      (4) Connect open flap up line to test stand pressure hose.

      (5) Disconnect flap return line from inlet port of auxiliary pump alternate reservoir. Connect this line to test stand return hose.

      (6) Remove thermal relief valve from tee in flap up line, located at STA X_{rs} = 70 in right wing root. Cap tee.



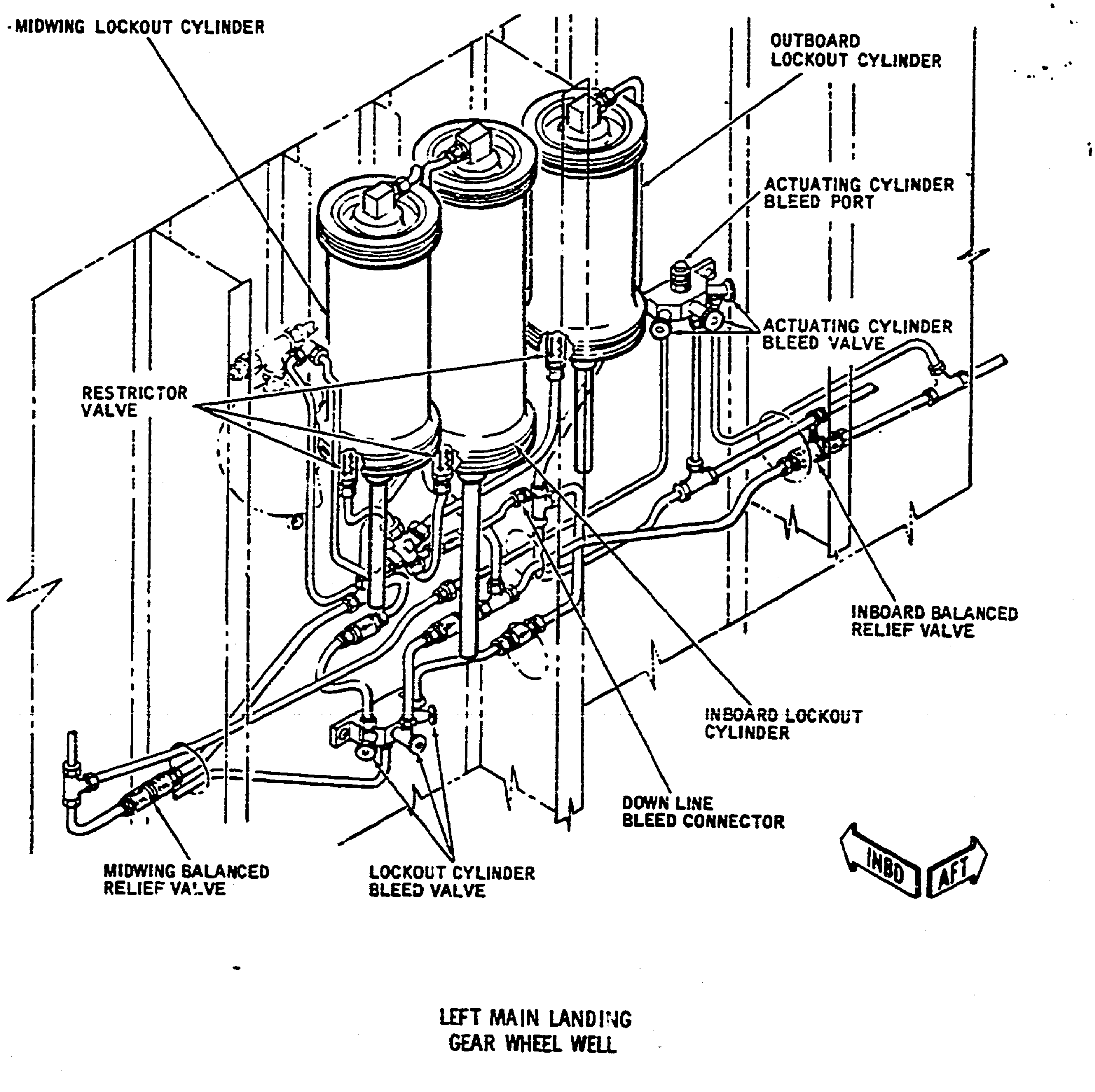
RIGHT POWER MANIFOLD



ALTERNATE RESERVOIR

HA2-6108A

Flushing Procedure Line Connection Locations
Figure 601



Flushing Procedures -- Line Connection Location
Figure 601A

(7) Disconnect hoses from outboard flap actuating cylinders. Plug all hoses.

(8) At inboard and midwing flap actuating cylinders, disconnect flap up and flap down pressure lines and install jumper between both set of lines.

(9) Disconnect bottom line from flap lockout cylinder bleed valve manifold (see Figure 601A).

(10) Remove lines and check valves (3) from top of bleed valve manifold.

(11) Connect jumper between line disconnected in step (9) and tee fitting below inboard lockout cylinder from which check valve was removed in step (10).

(12) Disconnect lines (3) from bottom of actuating cylinder bleed valve manifold.

(13) Connect jumper between bleed line for inboard actuating cylinder and down line bleed connector.

(14) Disconnect lines from top and bottom of inboard flap lockout cylinder and connect jumper between lines.

(15) At inboard and midwing balanced relief valve, disconnect and jumper lines.

(16) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(17) Shut off pressure source.

(18) Disconnect jumper from tee fitting below inboard lockout cylinder and connect to line below midwing lockout cylinder from which check valve was removed in step (10).

(19) Disconnect jumper from bleed line for inboard actuating cylinder and connect to bleed line for midwing actuating cylinder.

(20) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(21) Disconnect lines from top and bottom of inboard flap lockout cylinder and connect jumper between lines.

(22) Disconnect jumper from line below midwing lockout cylinder and connect to line below outboard lockout cylinder from which check valve was removed in step (10).

(23) Disconnect jumper from bleed line for midwing actuating cylinder and connect to bleed line for outboard actuating cylinder.

(24) At midwing flap actuating cylinders, remove jumpers. Plug flap down pressure lines.

(25) Connect jumper between midwing actuating cylinder up pressure line and outboard actuating cylinder down pressure lines.

(26) Pressurize test stand to 200 psi maximum at 20 gpm flow and flush circuit for five minutes.

(27) Shut off pressure source.

(28) Disconnect test stand pressure hose from flap up line. Connect line to wing flap control valve.

(29) Disconnect auxiliary pump case drain line from inlet port on side of alternate reservoir and from case drain of auxiliary pump.

(30) Connect test stand pressure hose and return hose to drain line, flush for three minutes.

(31) Disconnect auxiliary pump suction line at alternate reservoir and auxiliary pump selector valve.

(32) Disconnect test stand pressure hose and test stand return hose from auxiliary pump case drain line, and connect to auxiliary pump suction line, flush for three minutes.

(33) Remove jumpers at all flap actuating cylinders, flap lockout cylinders, flap control valve, and actuating cylinder bleed valve manifold. Connect airplane lines to applicable component.

(34) Bench flush short lines that run between lockout cylinder bleed valve manifold and check valve (removed in step 10).

(35) Install lines and check valves on lockout cylinder bleed valve manifold.

(36) Remove and bench flush short line that runs between thermal relief valve and tee in low-pressure return line.

NOTE: Steps (37) through (47) have been deleted.

(48) Inspect, clean, and/or replace all flap actuator cylinders, lockout cylinders thermal relief valve, balanced relief valves, restrictor valve, and flap control valve.

(49) Restore all lines and units to original configuration.

(50) Adjust rigging if necessary (see Chapter 27).

B. Wing Slot System

(1) Disconnect slots open and slots closed lines from wing slot control valve, located on right power manifold (see Figure 601).

(2) Connect slots open line to test stand pressure hose. Connect slots closed line to test stand return hose.

(3) Disconnect lines from 4 slot cylinders, cap all lines except outboard right cylinder lines. Install jumper across these two lines.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for three minutes.

(6) Depressurize test stand.

(7) Move jumper to right inboard slot cylinder lines, cap outboard lines, and repeat Steps (4 through 6).

(8) Repeat Steps (3 through 7) for left side. Make certain that all lines on both sides of airplane, with exception of jumpered lines, are capped.

(9) Inspect, clean, and/or replace wing slot cylinders and wing slot control valve, located on right power manifold.

(10) Restore all lines and units to original configuration. Adjust rigging if necessary per Chapter 27.

C. Main Gear Retract System (See Figures 602 and 603.)

(1) Disconnect gear up pressure line, gear down pressure line, and gear down return lines from main gear control valve.

(2) Connect jumper between gear down pressure line and gear down A-return line.

(3) Connect gear up line to test stand pressure hose.

(4) Disconnect gear down A-return line from tee in (nose gear return) A-return line, located in left wheel well aft of rear spar and below dual filter and relief valve. Connect line to test stand return hose.

(5) Disconnect right gear up and gear down lines from tees, located to right of centerline of airplane. Cap tees. Left gear retract system will be flushed first.

(6) In left wheel well, disconnect both main gear uplatch lines from tees in gear up and gear down lines. Cap tees.

(7) Disconnect both main gear door latch lines from tees in gear up and gear down lines near wing root. Cap tees.

(8) Disconnect downlock bungee pressure line from tee in gear up line. Cap tee.

(9) Disconnect line, which leads to bungee cylinder, from tee in gear down line. Cap tee.

(10) Disconnect line, which leads to gear door manual open valve, from tee in main gear down line. Cap tee.

(11) Replace restrictor in gear down line with jumper.

(12) Disconnect gear up and gear down lines from upstream side of actuating cylinder swivel gland. Connect jumper between these lines.

(13) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(14) Flush circuit for five minutes.

(15) Depressurize test stand.

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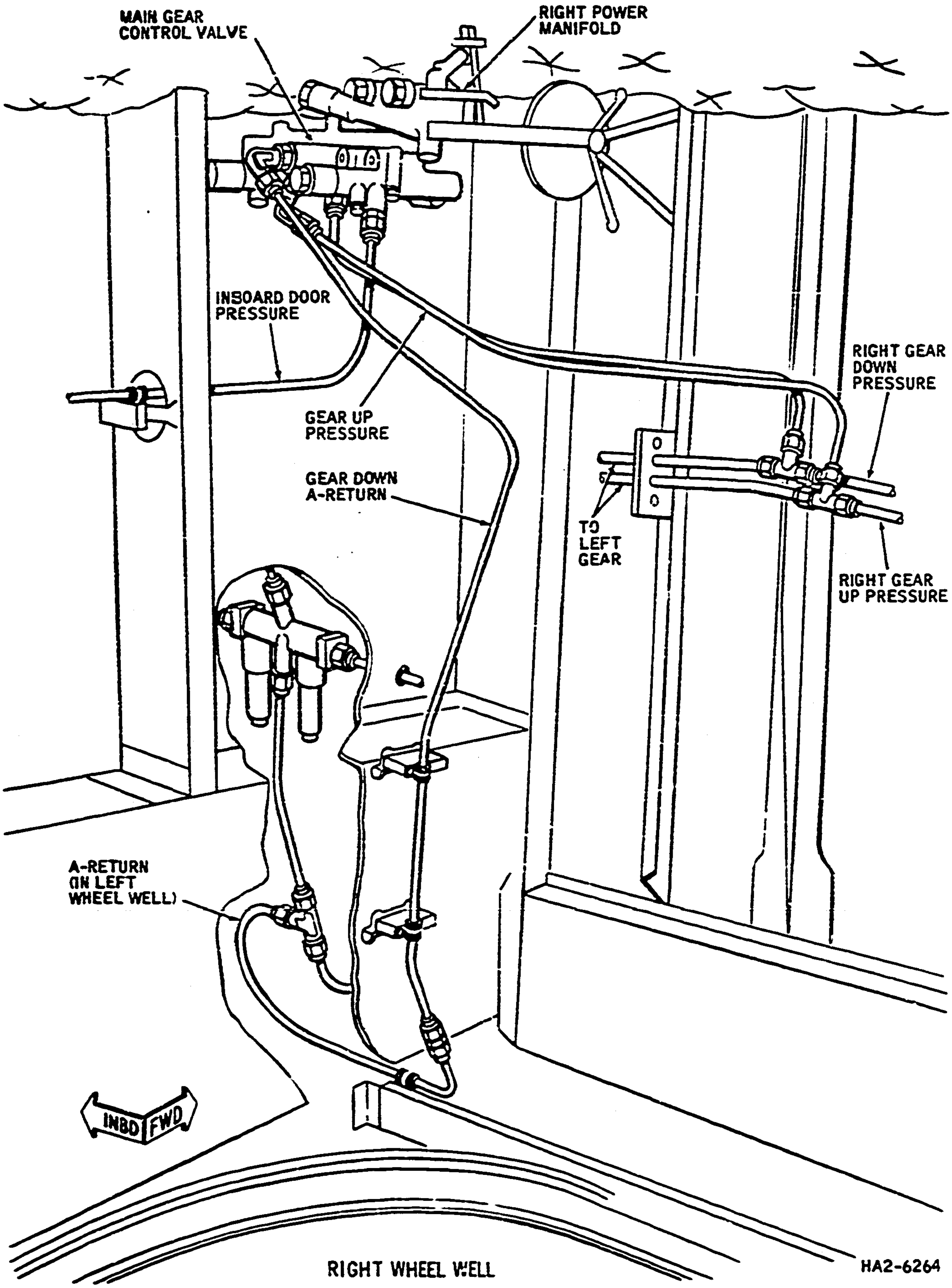
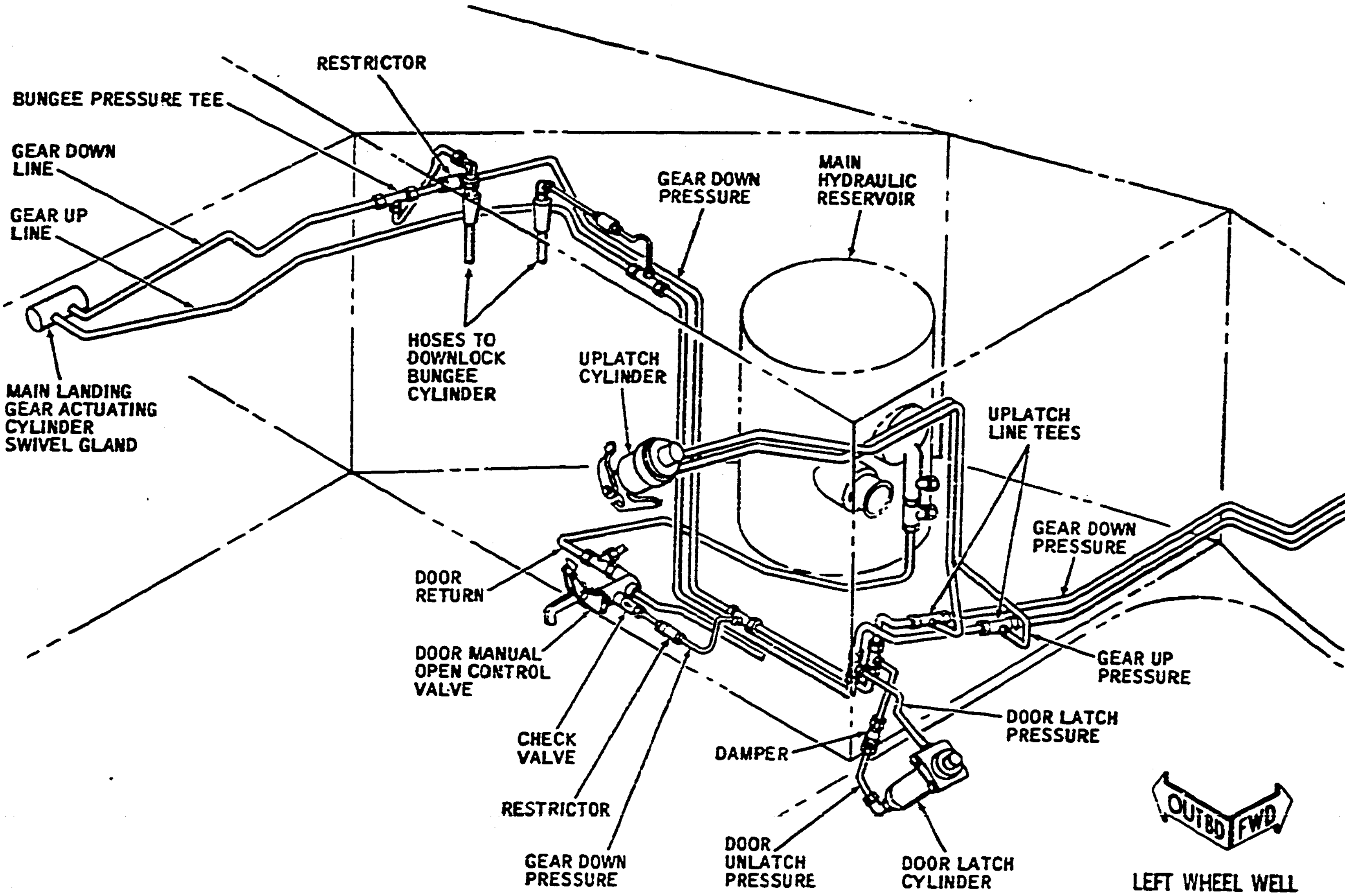


Flushing Procedure Line Connection Locations
Figure 602



Flushing Procedure Line Connection Locations
Figure 603

(16) Inspect, clean, and/or replace actuating cylinder and attaching swivel gland, door latch assembly and attaching lines (which include damper), downlock bungee cylinder and connecting lines including 2 hoses, restrictors and several short lines.

(17) Disconnect gear uplatch lines from gear uplatch cylinder and connect jumper between lines.

(18) Connect this circuit to test stand pressure and return hoses and flush for 3 minutes. Use same pressure as in Step (13).

(19) Inspect, clean, and/or replace main gear uplatch cylinder.

(20) Restore all lines and units on left side of airplane to original configuration.

(21) Connect test stand pressure hose to right gear down line, and test stand return hose to right gear up line. These lines were capped in Step (5).

(22) Repeat Steps (6 through 20) for right side of airplane.

(23) Make any necessary adjustments per Chapter 32.

D. Main Gear Door System

(1) Disconnect right main gear door lines from bulkhead tees in center web of airplane. Cap tees.

(2) Disconnect pressure and return lines from left door actuating cylinder swivel gland. Place jumper across these lines.

(3) Disconnect door return line from inboard side of door manual open valve. Connect line to test stand return hose.

(4) Disconnect door pressure line from main gear control valve. Connect line to test stand pressure hose.

(5) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(6) Flush circuit for three minutes.

(7) Depressurize test stand.

(8) Disconnect pressure and return lines from right door actuating cylinder swivel gland. Connect jumper across these lines.

(9) Connect test stand pressure and return hoses to lines that were capped in Step (1).

(10) Repeat Steps (5 through 7) for these lines.

(11) Inspect, clean, and/or replace both door actuating units, lines, and swivel glands.

(12) Inspect, clean, and/or replace door manual open valve, short line between manual open valve and tee in down line (this line includes restrictor and check valve) and line which runs from tee in manual open valve to reservoir fitting.

(13) Restore all lines and units to original configuration, and make any necessary adjustments per Chapter 32.

E. Bogie Trim System (See Figure 604)

(1) Disconnect bogie trim pressure line from cross fitting below priority valve.

(2) Connect test stand pressure hose to bogie trim pressure line.

(3) Disconnect bogie trim pressure line, which leads to right gear, at tee located below left power manifold and to left of airplane centerline. Cap tee.

(4) Disconnect bogie trim cylinder pressure hose at forward manifold on left main gear strut.

(5) Connect test stand return hose to manifold port.

(6) Install jumper lines around main gear swivel gland in bogie trim pressure line.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

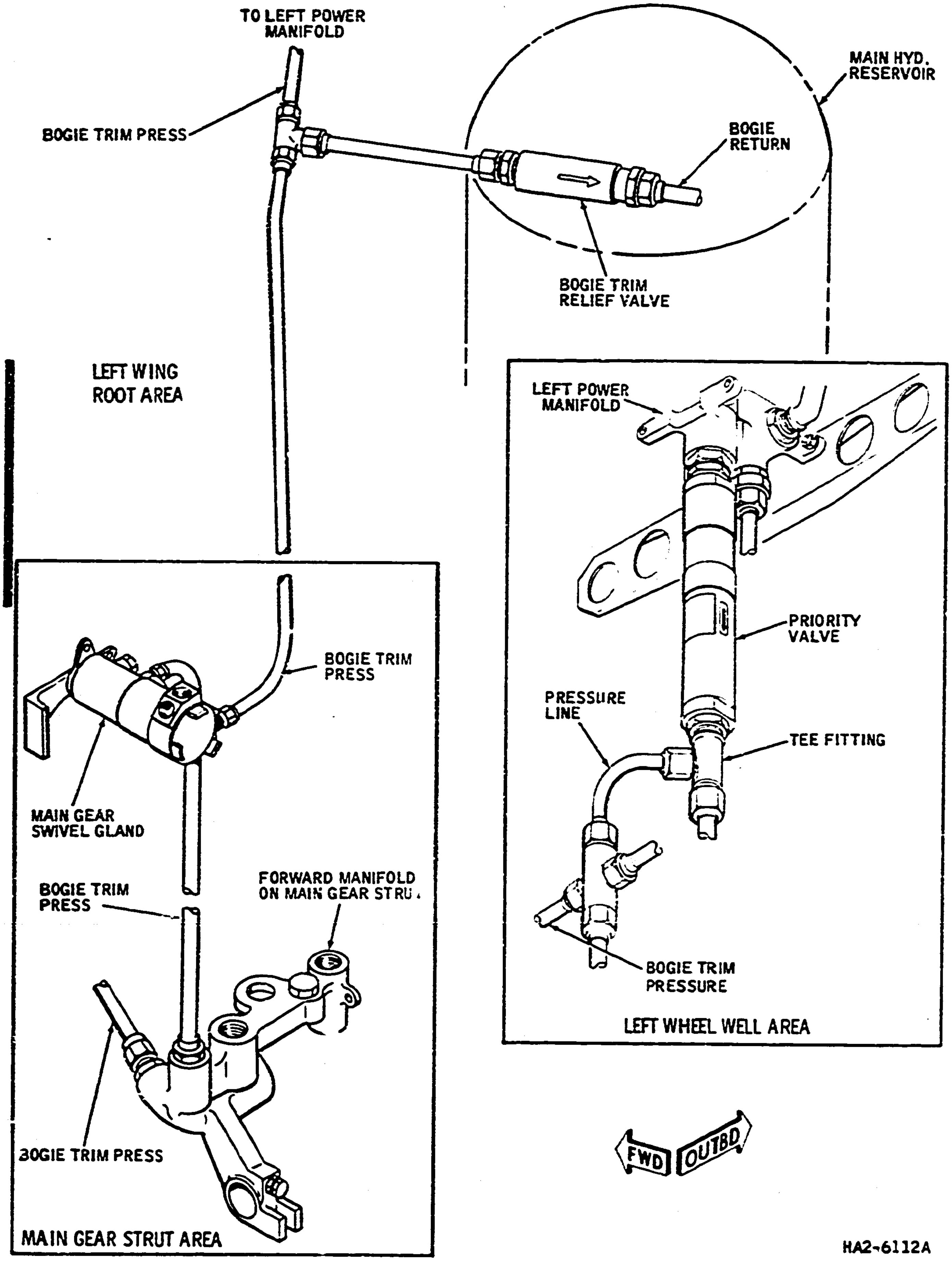
(10) Inspect, clean, and/or replace bogie trim relief valve, swivel gland, located at top of main gear strut, and bogie trim cylinder with attaching hoses, short lines between tee in bogie trim pressure line and relief valve, between relief valve and manual door open valve on left side of airplane, and between relief valve and antiskid valve.

(11) Connect right bogie trim pressure line to tee from which it was disconnected in Step (3). Disconnect left bogie trim pressure line from this tee, and cap tee.

(12) Disconnect test stand return hose from left forward manifold and connect it to bogie trim port on right main rear forward manifold.

(13) Repeat Steps (5 through 10) for right side of airplane.

(14) Restore all bogie trim lines, hoses, and units to original configuration.



Flushing Procedure Line Connection Locations
Figure 604

F. Nose Gear System (See Figures 605 and 606.)

(1) Disconnect nose gear down line from tee just inboard of nose gear control valve. Connect line to test stand pressure hose.

(2) Disconnect actuating cylinder gear down hose from tee in gear down line, located on left side of nosewheel well. Cap tee.

(3) Jumper check valve in steering pressure line, which runs from tee for actuating cylinder down hose to tee which branches to reserve accumulator shutoff valve and pressure line running forward.

(4) At tee between check valve, removed in Step (3), and reserve accumulator shutoff valve, disconnect steering pressure line which leads forward. Cap tee.

(5) Disconnect pressure line from left side of reserve accumulator shutoff valve. Place jumper between this line and line which was disconnected in Step (4).

(6) Replace check valve in steering pressure line, located aft of nosewheel steering valve, with jumper.

(7) Disconnect all four lines from steering control valve. Connect jumpers between pressure line and steer right line, and between return line and steer left line.

(8) On airplanes without nose gear steering bypass valve, perform Steps (a) through (c).

(a) Disconnect five steering lines from swivel gland and tee located on cross arm. Connect jumper across two open steer left lines located on opposite sides of swivel gland. Connect jumper across two steer right lines which were disconnected from same tee in swivel gland.

(b) Disconnect at steering cylinder glands, three steering lines which run from swivel gland on crossarm to glands at steering cylinders.

(c) Install jumper across two lines on right cylinder. On left cylinder, install jumper from open line to open steer-right line upstream of swivel gland on crossarm.

(9) On airplanes equipped with nose gear steering bypass valve, perform Steps (a) through (h).

(a) Disconnect four steering lines from swivel gland located on crossarm. Connect jumper across two open steer left lines. Connect jumper across two open steer right lines.

(b) At steering relief valve, disconnect six steering lines.

(c) Connect jumper between steer left inlet line and one of steering lines to right steering cylinder.

(d) Connect jumper between steer right inlet line and one of steering lines to left steering cylinder.

(e) Jumper remaining left cylinder line to remaining right cylinder line.

(f) Disconnect and jumper two lines at right steering cylinder swivel glands.

(g) Disconnect and jumper two lines at left steering cylinder swivel glands.

(h) Disconnect and remove for cleaning, short bypass valve return line between crossarm swivel gland and bypass valve.

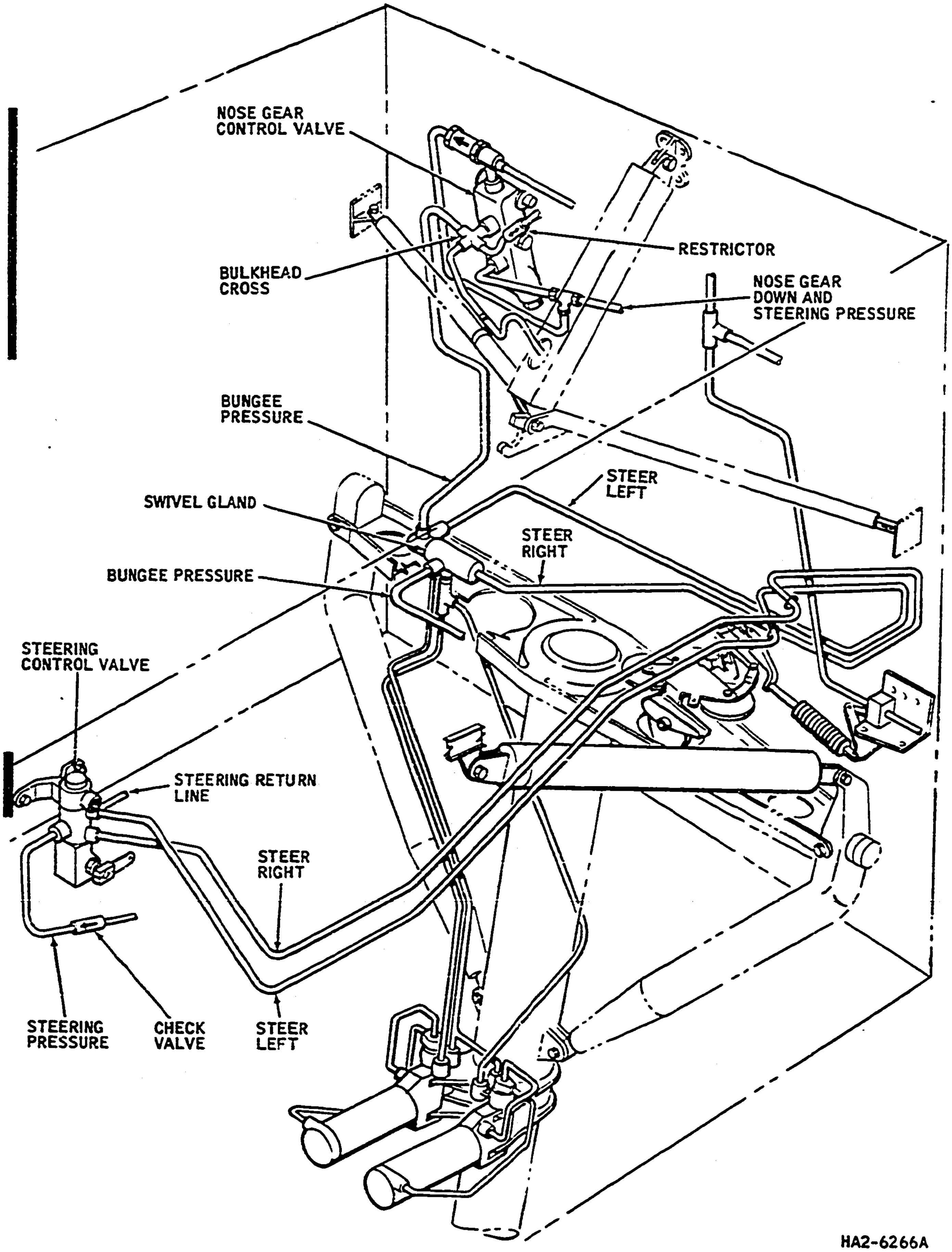
(10) Disconnect steering return line from lower side of tee in steering relief valve. Disconnect gear actuating cylinder up hose at cylinder. Connect jumper between this open line and hose.

(11) Disconnect 1/4-inch up line from restrictor on side away from control valve. Disconnect 1/4-inch bungee line at bulkhead cross fitting at control valve. Connect jumper across these two open lines.

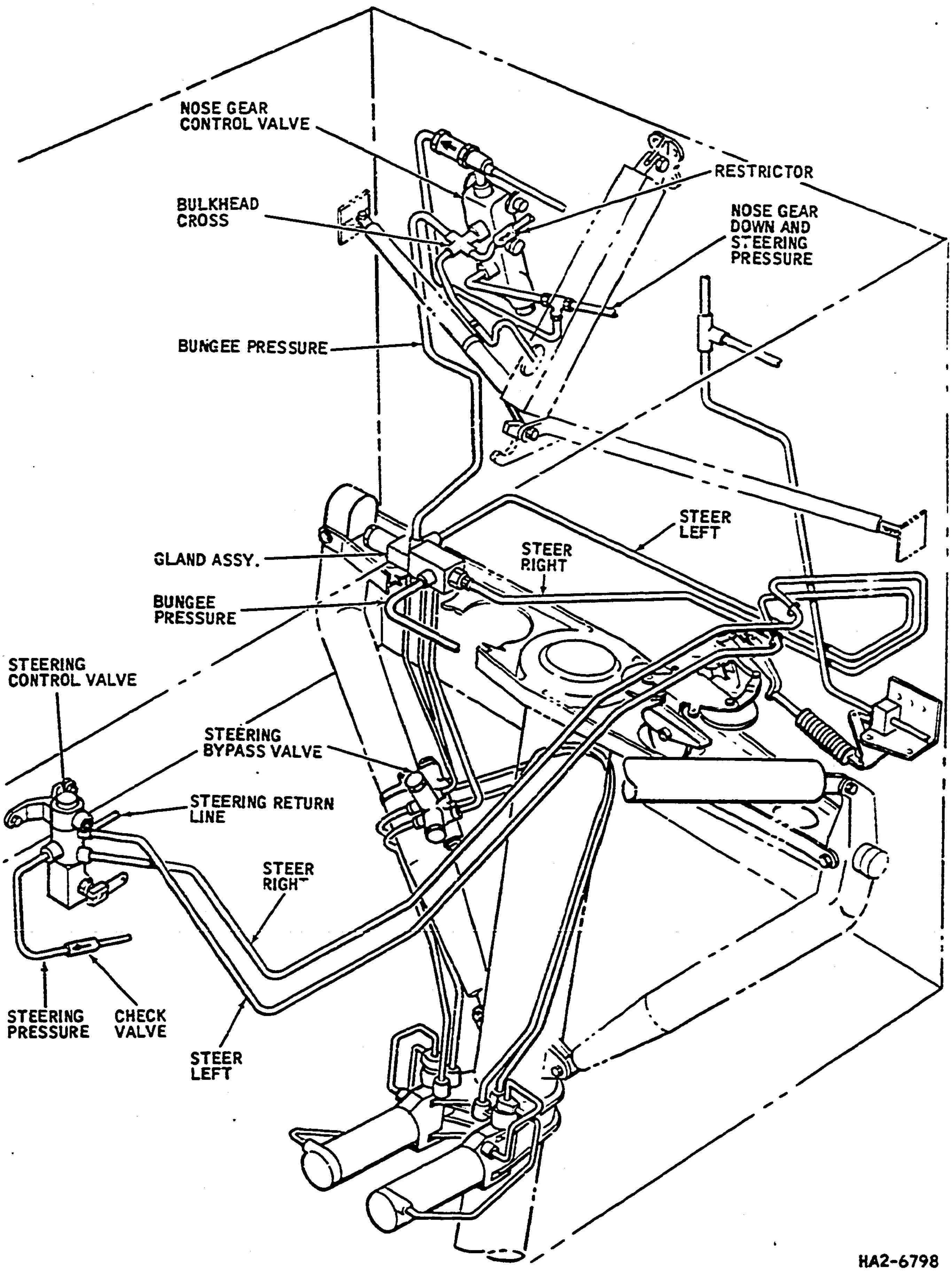
(12) On airplanes without nose gear steering bypass valve, disconnect bungee line from top of swivel gland and connect to test stand return hose.

(13) On airplanes equipped with nose gear steering bypass valve, disconnect bungee line from top of swivel gland and bypass valve return line at outboard side of swivel gland. Connect jumper between open lines. Disconnect bypass valve return line from bulkhead tee below steering relief valve and connect test stand return hose to line.

(14) Pressurize test stand to 200 psi maximum at 20 gpm flow.



Flushing Procedure Line Connection Locations
(Airplanes Without Steering Bypass Valve)
Figure 605



Flushing Procedure Line Connection Locations
(Airplanes With Steering Bypass Valve)
Figure 605A

(15) Flush circuit for five minutes.

(16) Depressurize test stand.

(17) Inspect, clean, and/or replace relief valve, bleeder valve, return accumulator and two associated lines, nose gear actuating cylinder and attaching hoses, bungee cylinder and attaching line, swivel gland mounted on crossarm, uplatch cylinder and two lines which connect it to control valve.

(18) Inspect, clean, and/or replace nosewheel steering valve, located on outboard side of left side of wheel well and steering bypass valve on airplanes so equipped.

(19) Inspect, clean, and/or replace nosewheel steering cylinders, restrictors, and gland assemblies and associated lines; nosewheel steering control valve, reserve accumulator shutoff valve and associated lines, and check valves.

(20) Restore all lines and units to original configuration, and make any necessary adjustments as described in Chapter 32.

G. Wheel Brake System Pressure Lines

(1) Disconnect right gear brake pressure line from brake control valve, and connect test stand pressure hose to this line (see Figure 607).

(2) Disconnect two brake pressure lines from swivel gland at top of main landing gear strut. Connect these lines with a jumper line.

(3) Disconnect brake pressure line from upstream side of tee fitting at dual servo valves.

(4) Disconnect four brake pressure outlet lines from servo valves. Connect jumper line between pressure inlet line and one pressure outlet line. Cap other three outlet lines.

(5) Disconnect inlet and outlet lines and jumper fluid quantity limiter (or lockout cylinder) in outlet line connected in Step (4).

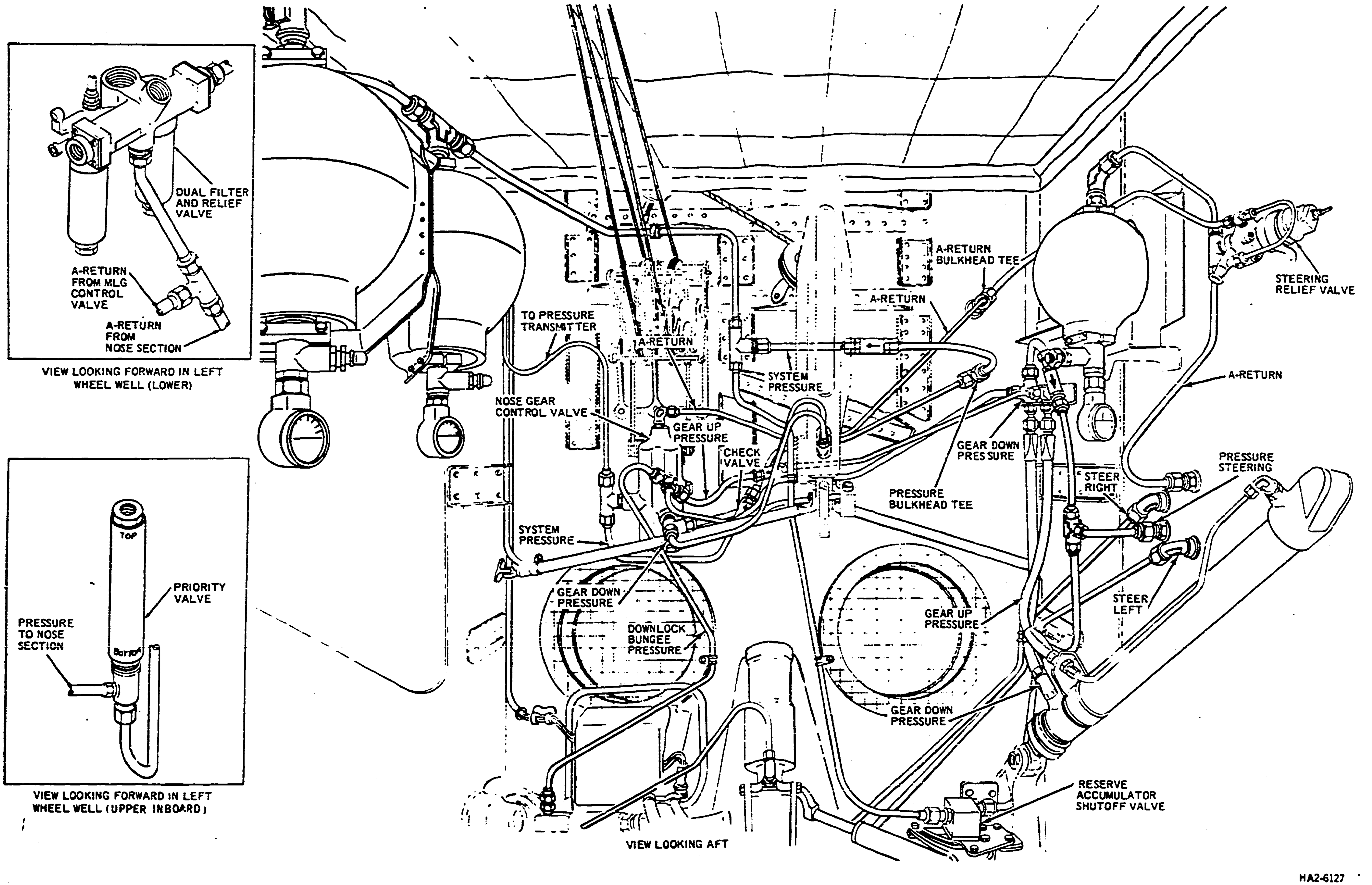
(6) Disconnect brake hose from corresponding brake, and connect hose to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

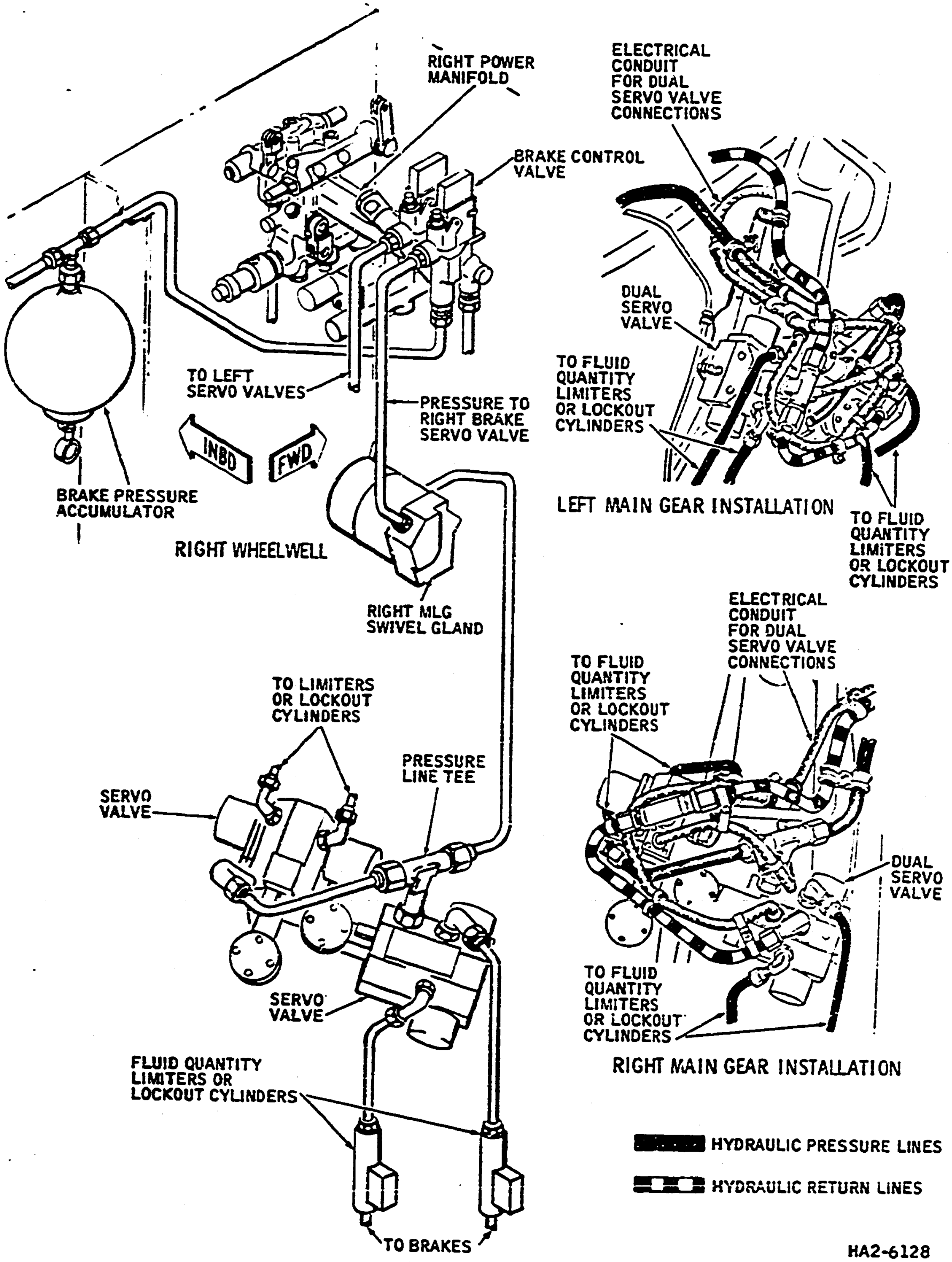
(8) Flush circuit for five minutes.

(9) Depressurize test stand.

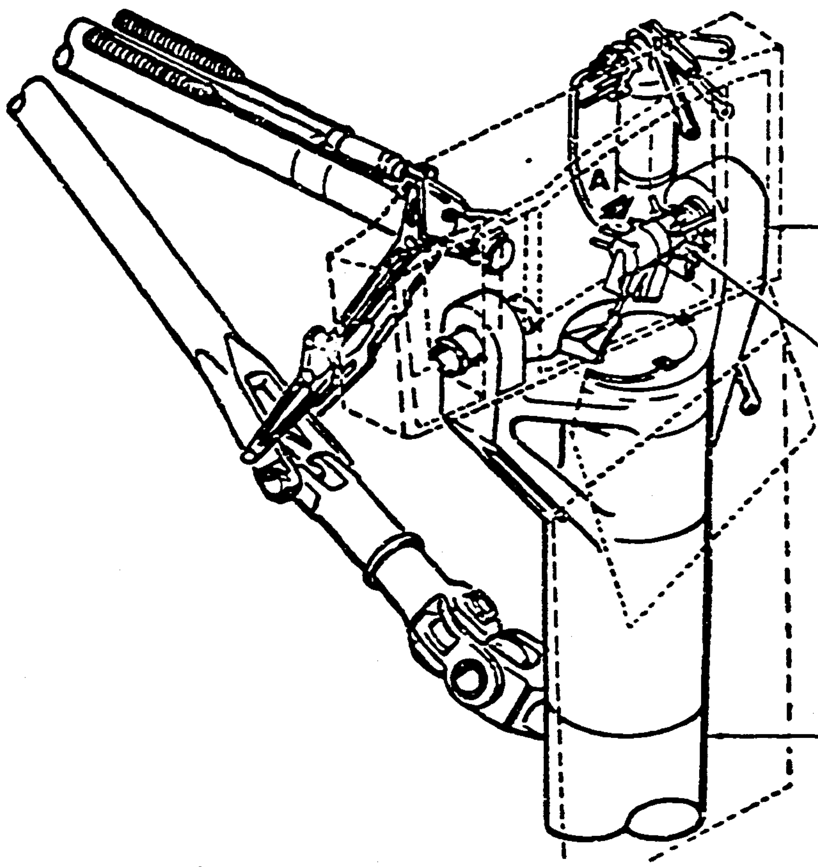
(10) Disconnect jumper line from outlet line connected in Step (4), cap outlet line, and connect jumper to one of other three outlet lines.

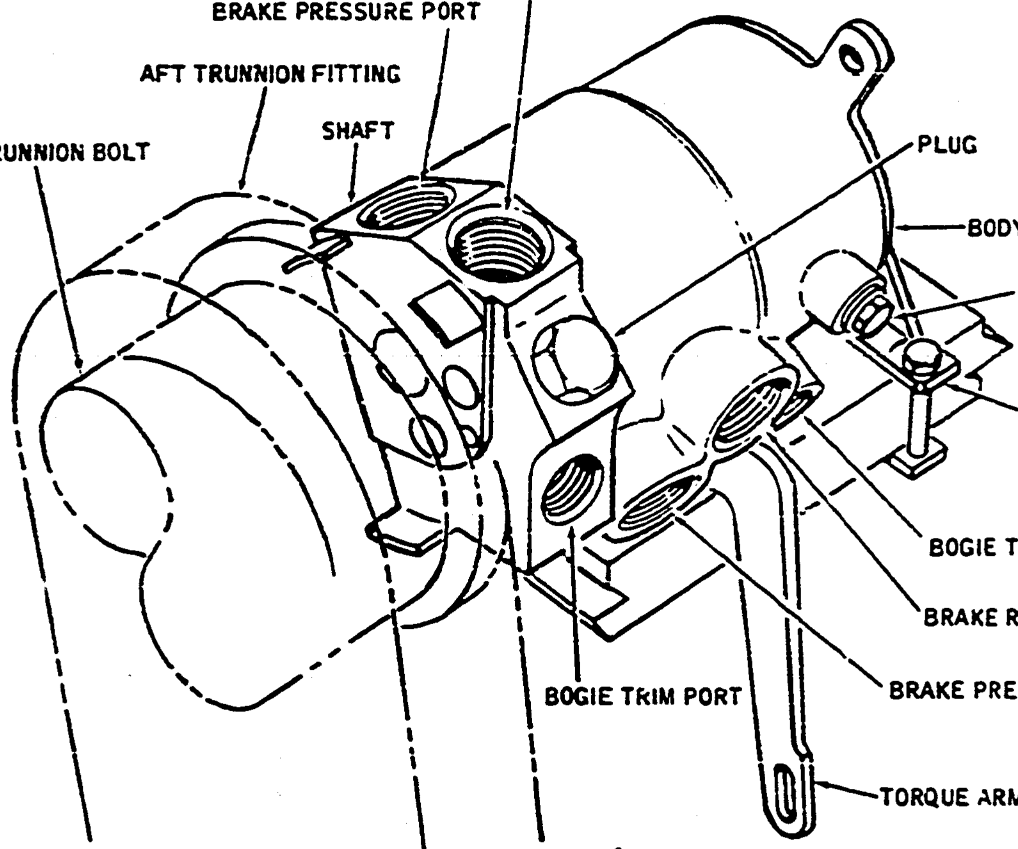


Flushing Procedure Line Connection Locations
Figure 606



Flushing Procedure Line Connection Locations
Figure 607 (Sheet 1)





Flushing Procedure Line Connection Locations
Figure 607 (Sheet 2)

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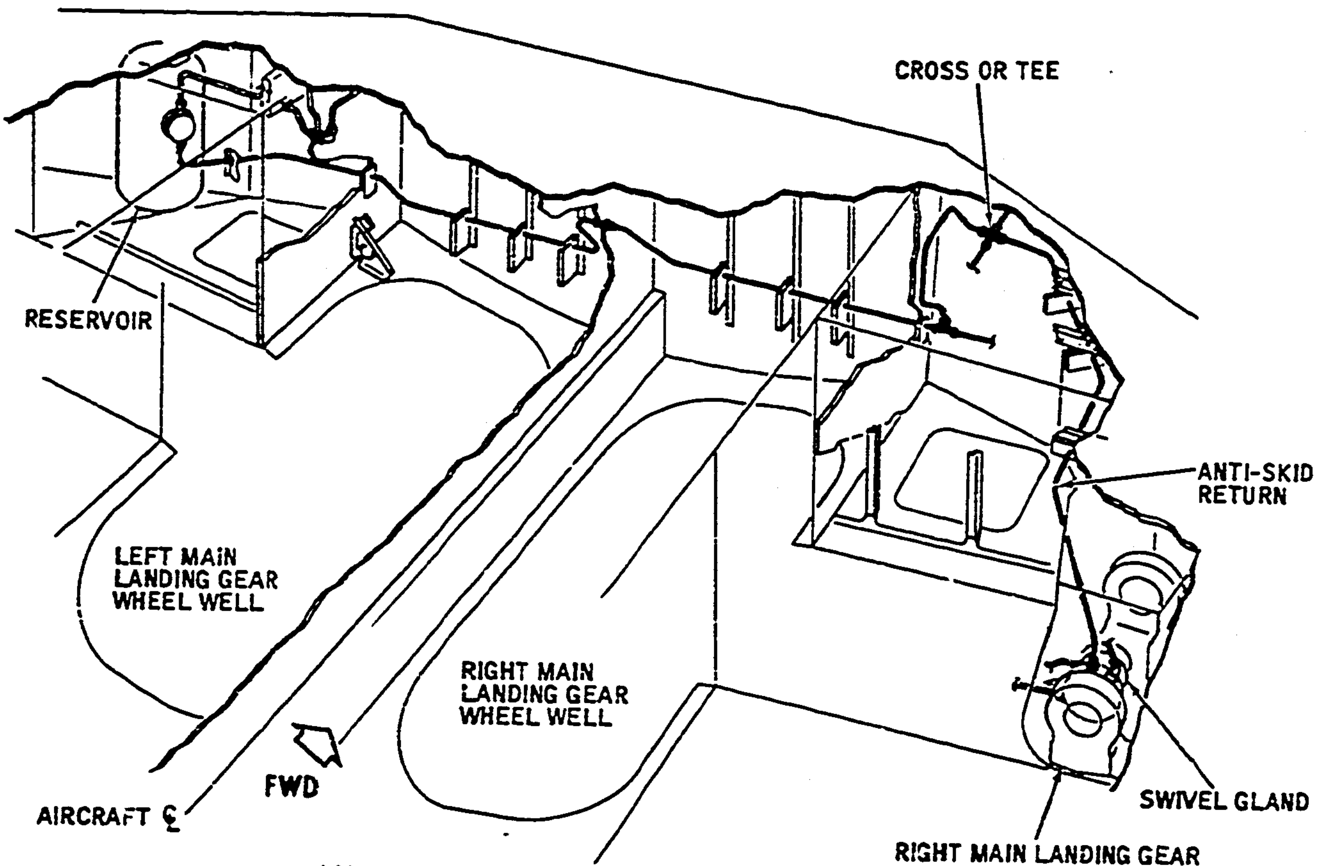
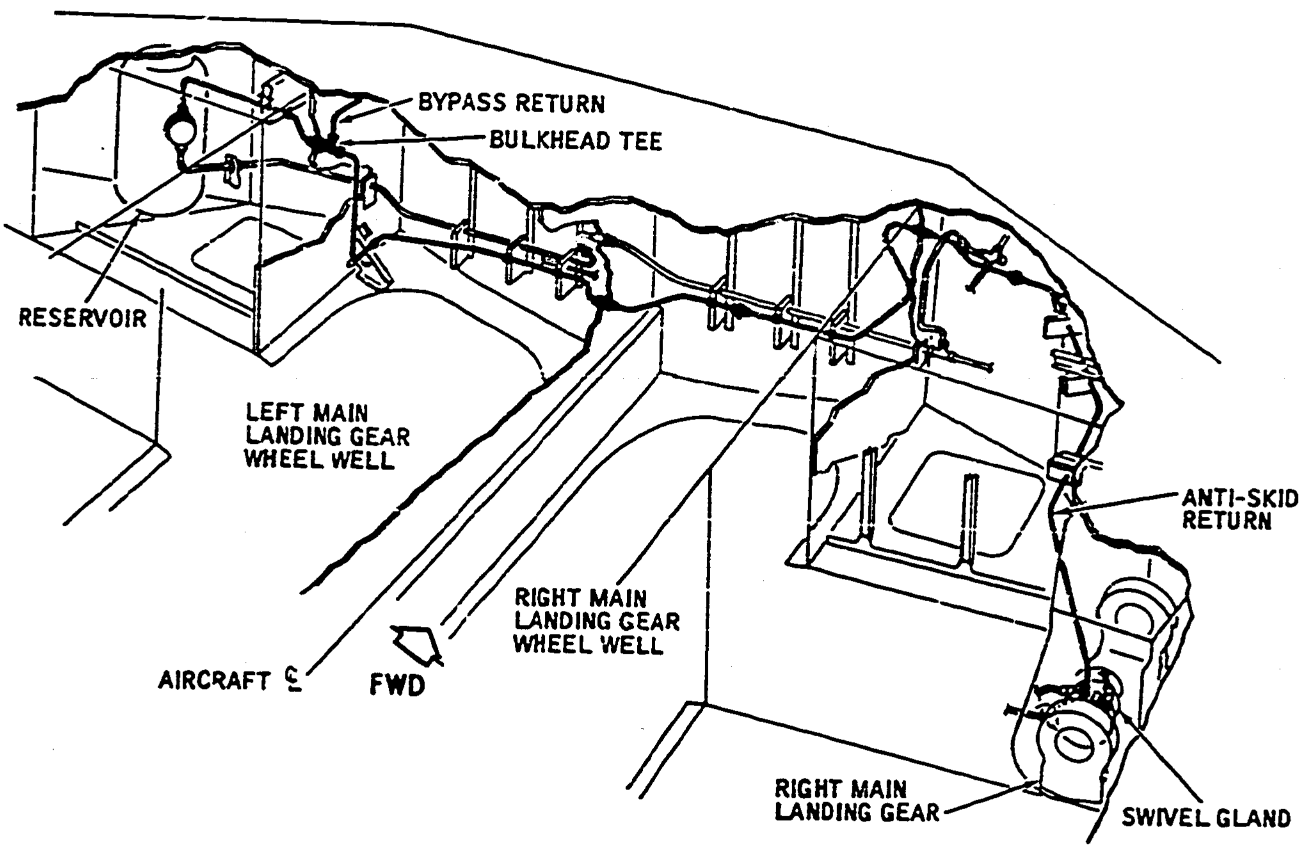


AIRPLANES WITHOUT DIRECT RETURN LINE



AIRPLANES WITH DIRECT RETURN LINE

HA2-6802

Flushing Procedure Line Connection Locations
Figure 607 (Sheet 3)

(11) Repeat Steps (5 through 10) to flush remaining servo valve outlet lines.

(12) Inspect, clean and/or replace brake control valve, main landing gear swivel gland, dual servo valves, fluid quantity limiters (or lockout cylinders).

(13) Disconnect test stand pressure hose from right gear brake pressure line at control valve, and connect to left gear brake pressure line at left brake control valve.

(14) Repeat Steps (2 through 12) to flush left brake system pressure lines.

(15) Restore all lines and units to original configuration.

(16) To flush brake accumulators and check valve system, disconnect pressure line which runs from right power manifold to tee on accumulator. Connect test stand return hose to line that was disconnected at accumulator tee.

(17) Remove brake inlet check valve seat, spring, and poppet from right power manifold. Install seat only with seals.

(18) Remove pressure line from tee at bottom of priority valve, located below left power manifold, and connect this line to test stand pressure hose.

(19) Pressurize test stand to 200 psi at 5 to 20 gpm flow.

(20) Flush circuit for five minutes.

(21) Depressurize test stand.

(22) Remove inlet check valve seat. Examine check valve assembly for evidence of improper seating and magnetization. Install new check valve assembly if required.

(23) Remove accumulators and connecting line. Clean and flush on bench.

(24) Restore all lines and units to original configuration. Bleed and adjust brake system per Chapter 32.

H. Wheel Brake System Return Lines

(1) Disconnect right anti-skid servo valve return line at tee fitting on upper servo valve on right main gear strut. Connect test stand pressure hose to this line.

(2) Disconnect two return lines from swivel gland at top of main gear strut. Connect these lines with jumper line.

(3) On airplanes not equipped with right brake anti-skid direct return line, disconnect anti-skid return line from tee fitting in aileron A return line, located in right wing root area (see Figure 607). Cap A-return tee fitting. Disconnect bogie relief valve at tee and cap line.

(4) On airplanes equipped with right brake anti-skid direct return line, disconnect right brake anti-skid return line from bulkhead tee in bypass return line on outboard bulkhead of left wheel well.

(5) Connect test stand return hose to anti-skid line at tee disconnected in Step (3) or (4) as applicable.

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Restore all lines and units to original configuration.

(10) Disconnect left anti-skid servo valve return line at tee fitting on upper servo valve on left main gear strut. Connect test stand pressure hose to this line.

(11) Disconnect two return lines from swivel gland at top of main gear strut. Connect these lines with jumper line.

(12) Disconnect left bogie relief valve from anti-skid return line at tee fitting. Cap line and tee.

(13) Disconnect left anti-skid return line from tee fitting in B-return port of main reservoir. Cap tee fitting.

(14) Connect test stand return hose to this line.

(15) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(16) Flush circuit for five minutes.

(17) Depressurize test stand.

(18) Restore all lines and units to original configuration.

FLIGHT POWER CONTROL SYSTEMS - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the flight power control systems by flushing the systems with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand Section 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Flight Power Control Systems

A. Aileron Power System

(1) On left side of airplane, remove, inspect, clean and/or replace aileron power valve, power cylinder, lockout tab cylinder, and associated piping (including lines, glands, and restrictors) downstream of aileron filter and outboard of return manifold located at STA X_{rs} = -500.

(2) Repeat Step (1) for right aileron power system.

B. Rudder Power System (See Figures 601 and 602.)

(1) In tail of airplane aft of pressure bulkhead, disconnect three horizontal stabilizer trim lines from tees in three rudder lines. Cap tees.

(2) On aft side of pressure bulkhead, disconnect B-return and low-pressure return lines. On downstream side of filter, disconnect empennage pressure line and connect it to test stand pressure hose.

(3) Connect jumper across open B-return and low-pressure return lines.

(4) Where rudder standby pressure line tees into normal pressure line, remove line and check valve. Cap tee.

(5) In same tee, mentioned in Step (4), remove other check valve in normal pressure line and replace with jumper.

(6) Disconnect line which runs from check valve in shutoff valve to tee in B-return line at tee. Cap tee.

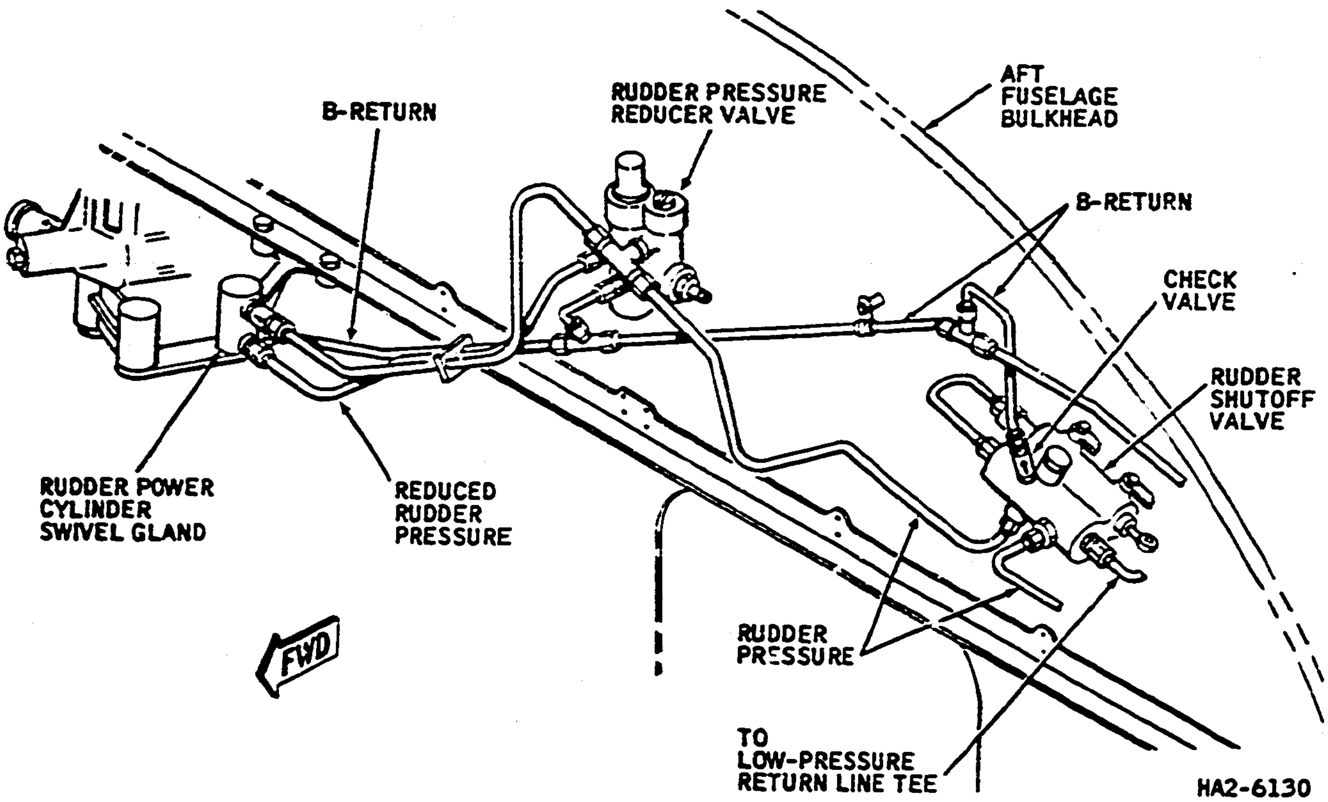
(7) At rudder shutoff valve, disconnect low-pressure return line from tee and connect to test stand return hose.

(8) At same valve, Step (7), disconnect pressure-in line and pressure-out line. Place jumper across two lines.

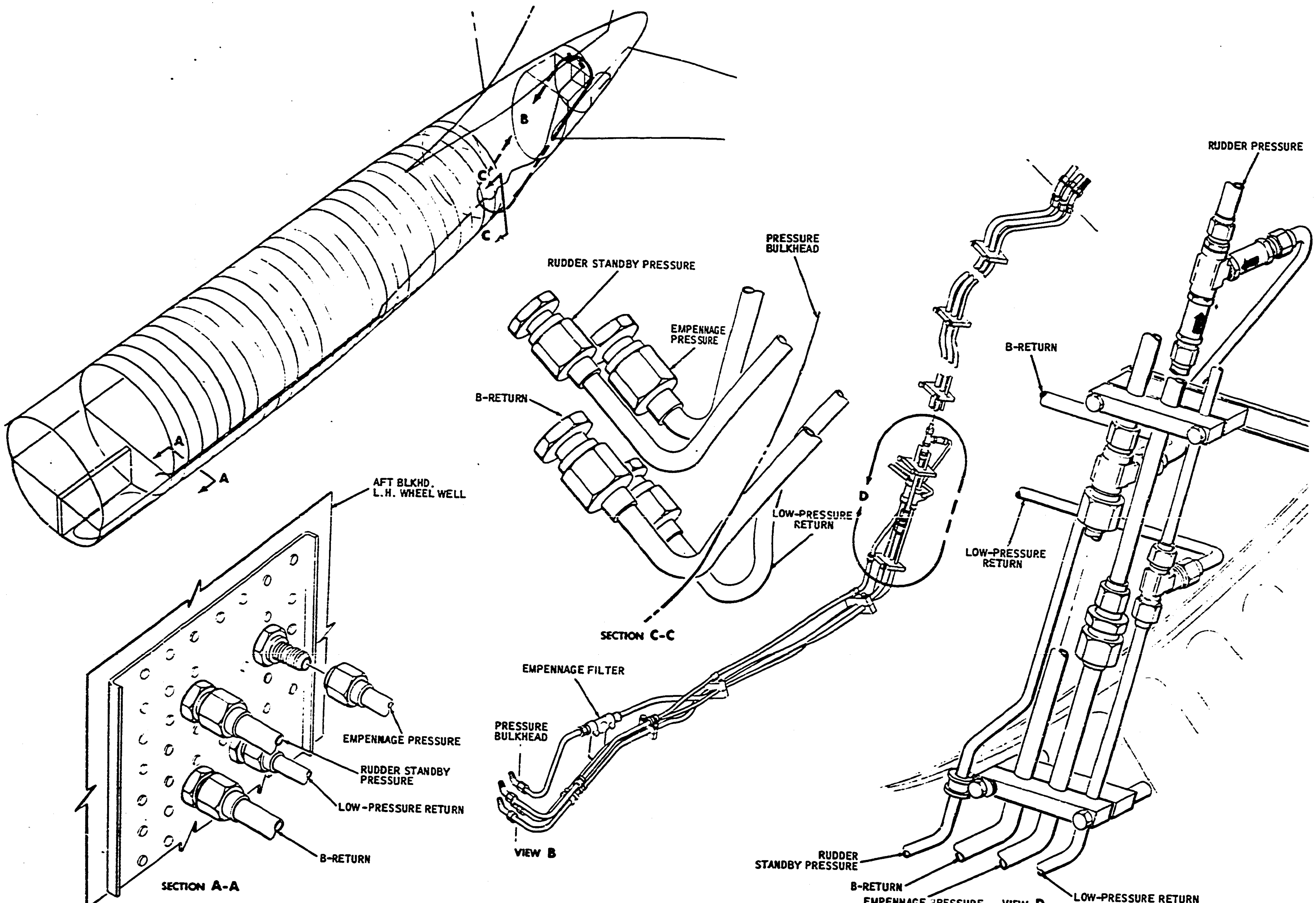
(9) Disconnect line from pressure reducer valve to tee in return line. Cap tee.

(10) At tee in pressure reducer valve, disconnect both pressure lines and connect together with jumper.

(11) Disconnect reduced pressure line from pressure reducer valve, and disconnect pressure line from restrictor check valve in rudder power cylinder swivel gland. Place jumper across these two open lines.



Flushing Procedure Line Connection Locations
Figure 601



Flushing Procedure Line Connection Locations
Figure 602

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(12) Disconnect reduced pressure line from check valve in swivel gland, and disconnect return line from swivel gland. Place jumper across these two lines.

(13) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(14) Flush circuit for five minutes.

(15) Depressurize test stand.

(16) Inspect, clean, and/or replace rudder shutoff valve, pressure reducer valve, rudder power control cylinder, swivel gland, and all removed check valves and restrictors.

(17) Restore all lines and units to original configuration, and make any necessary adjustments per Chapter 27.

C. Horizontal Stabilizer Trim System

(1) Disconnect three stabilizer trim lines from tees in rudder power system lines.

(2) Place jumper across B-return and low-pressure return lines.

(3) Connect open pressure line to test stand pressure hose.

(4) Disconnect low-pressure return line from trim motor control valve cross fitting. Disconnect B-return line from control valve. Disconnect pressure line from shutoff valve.

(5) Connect jumper between open pressure line, and open B-return line.

(6) Connect open low-pressure return line to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for three minutes.

(9) Depressurize test stand.

(10) Inspect, clean, and/or replace hydraulic trim motor-brake, valves, and associated piping.

(11) Restore all lines and units to original configuration.

SPOILER SYSTEM - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the spoiler system by flushing the system with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand Section 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smal[illegible] filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Spoiler System

A. Spoiler Power System to Filter

(1) After bleeding pressure and hydraulic fluid from spoiler system reservoir, disconnect bypass hose and pressure hose from bottom of pump. Connect two hoses together with union.

(2) At reservoir, disconnect suction hose and case drain hose. Jumper these two hoses together.

(3) Disconnect suction line from pump and connect to test stand pressure hose.

(4) Disconnect both pressure lines at tee in accumulator. Place jumper across these lines.

(5) At relief valve just forward of filter, disconnect pressure line from upper tee, and disconnect return line from forward side of bottom tee. Place jumper across open lines.

(6) Disconnect return line from tee in reservoir, and connect open line to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) Inspect, clean, and/or replace accumulator, and two relief valves (one at reservoir and one at filter).

(11) Clean out filter bowl and replace element.

(12) Clean out reservoir and refill with clean fluid after connecting all lines and units. Restore system to original configuration.

B. Spoiler Supply System Filter to Units

(1) Disconnect pressure line from check valve in spoiler system filter. Connect line to test stand pressure hose.

(2) Disconnect interconnect pressure line from tee in spoiler system pressure line. Cap tee.

(3) Following pressure line to next tee, disconnect line which runs forward. Cap tee.

(4) At pressure bulkhead tee fitting in center web (tee which supplies outboard spoiler pressure to both sides of airplane), disconnect line which runs to right. Cap tee.

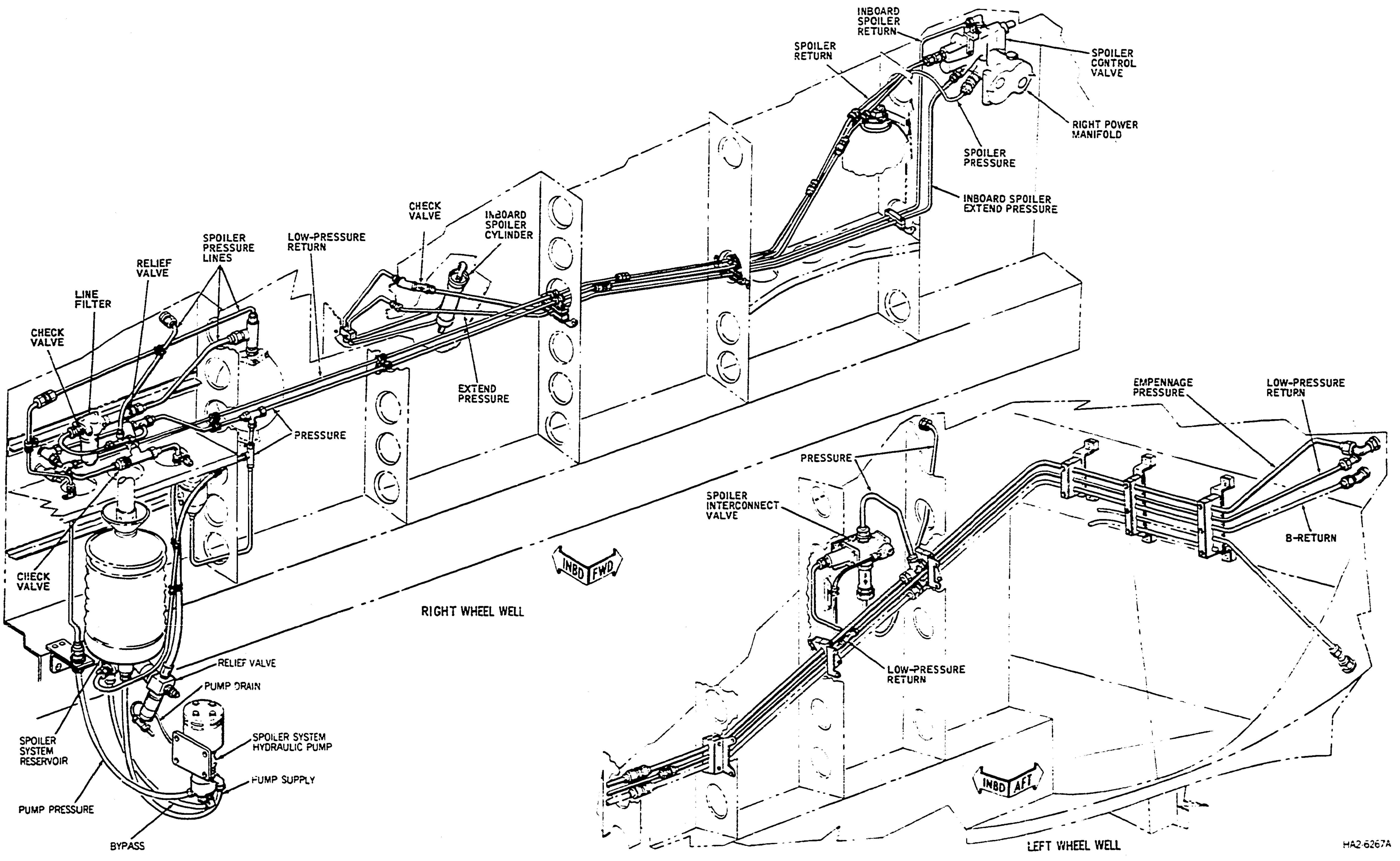
(5) At STA X_{rs} = approx. 217 on both sides of airplane, disconnect spoiler pressure and return lines from spoiler glands. Place jumpers between these lines on both sides of airplane.

(6) At tee in return bulkhead tee, located just under pressure bulkhead tee mentioned in Step (4), disconnect both lines which run forward. Cap tee and place jumper across two lines.

(7) Disconnect return line from check valve in tee at bottom of system pressure relief valve. Connect this line to line disconnected in Step (4) with jumper.

(8) At spoiler valve, located on right power manifold, disconnect spoiler return line. From same manifold, disconnect spoiler pressure line. Connect these two lines together with jumper.

(9) Connect jumper line to line which was disconnected in Step (3). In same line at next tee forward, disconnect line which leads down to pressure transmitter and reservoir. Cap tee and connect open line to other end of jumper.



Flushing Procedure Line Connection Locations
Figure 601

(10) Disconnect reservoir pressurization line from tee in pressure line. Disconnect pressure line from pressure transmitter. Connect two open lines with jumper, and cap tee.

(11) Disconnect reservoir pressurization line from bottom of reservoir, and connect line to test stand return hose.

(12) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(13) Flush circuit for five minutes.

(14) Depressurize test stand.

(15) Inspect, clean, and/or replace check valves in the filter, and in bottom of relief valve.

(16) Restore all lines and units to original configuration.

C. Outboard Spoiler System

(1) At STA X_{rs} = approx. 217, inspect, clean, and/or replace outboard spoiler cylinder and valve assembly, and connecting swivel glands.

(2) Restore all lines and units to their original configuration, and make any necessary adjustments per Chapter 27.

D. Inboard Spoiler System

(1) Disconnect extend and retract lines from spoiler control valve, located on right power manifold in right wheel well. Connect extend line to test stand pressure hose. Connect retract line to test stand return hose.

(2) On right side of the center web, replace restrictor in spoiler retract line with jumper.

(3) In rear of left wheel well, disconnect extend and retract lines from inboard spoiler cylinder. Place jumper across open lines.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Inspect, clean, and/or replace spoiler control valve, two restrictors, and actuating cylinder.

(8) Restore all lines and units to original configuration, and make necessary adjustments per Chapter 27.

E. The Interconnect System

(1) In right wheel well, disconnect interconnect line from tee in spoiler system pressure line, located near spoiler system filter. Connect this line to test stand return hose.

(2) In left wheel well, disconnect three lines leading into solenoid interconnect valve, mounted on center web. Leave check valve with solenoid valve.

(3) Connect jumper between line disconnected from check valve and line disconnected from pressure port.

(4) Disconnect solenoid valve low-pressure return line from tee in empennage low-pressure return line. Connect this line to test stand pressure hose.

(5) Disconnect solenoid valve pressure line from tee in empennage pressure line. Connect this line to disconnected case drain line in solenoid interconnect valve with jumper.

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Inspect, clean, and/or replace solenoid interconnect valve, and check valve.

(10) Restore all lines and units to original configuration.

SPOILER SYSTEM - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the spoiler system by flushing the system with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand Section 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Spoiler System

A. Spoiler Power System to Filter

(1) After bleeding pressure and hydraulic fluid from spoiler system reservoir, disconnect bypass hose and pressure hose from bottom of pump. Connect two hoses together with union.

(2) At reservoir, disconnect suction hose and case drain hose. Jumper these two hoses together.

(3) Disconnect suction line from pump and connect to test stand pressure hose.

(4) Disconnect both pressure lines at tee in accumulator. Place jumper across these lines.

(5) At relief valve just forward of filter, disconnect pressure line from upper tee, and disconnect return line from forward side of bottom tee. Place jumper across open lines.

(6) Disconnect return line from tee in reservoir, and connect open line to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) Inspect, clean, and/or replace accumulator, and two relief valves (one at reservoir and one at filter).

(11) Clean out filter bowl and replace element.

(12) Clean out reservoir and refill with clean fluid after connecting all lines and units. Restore system to original configuration.

B. Spoiler Supply System Filter to Units

(1) Disconnect pressure line from check valve in spoiler system filter. Connect line to test stand pressure hose.

(2) Disconnect interconnect pressure line from tee in spoiler system pressure line. Cap tee.

(3) Following pressure line to next tee, disconnect line which runs forward. Cap tee.

(4) At pressure bulkhead tee fitting in center web (tee which supplies outboard spoiler pressure to both sides of airplane), disconnect line which runs to right. Cap tee.

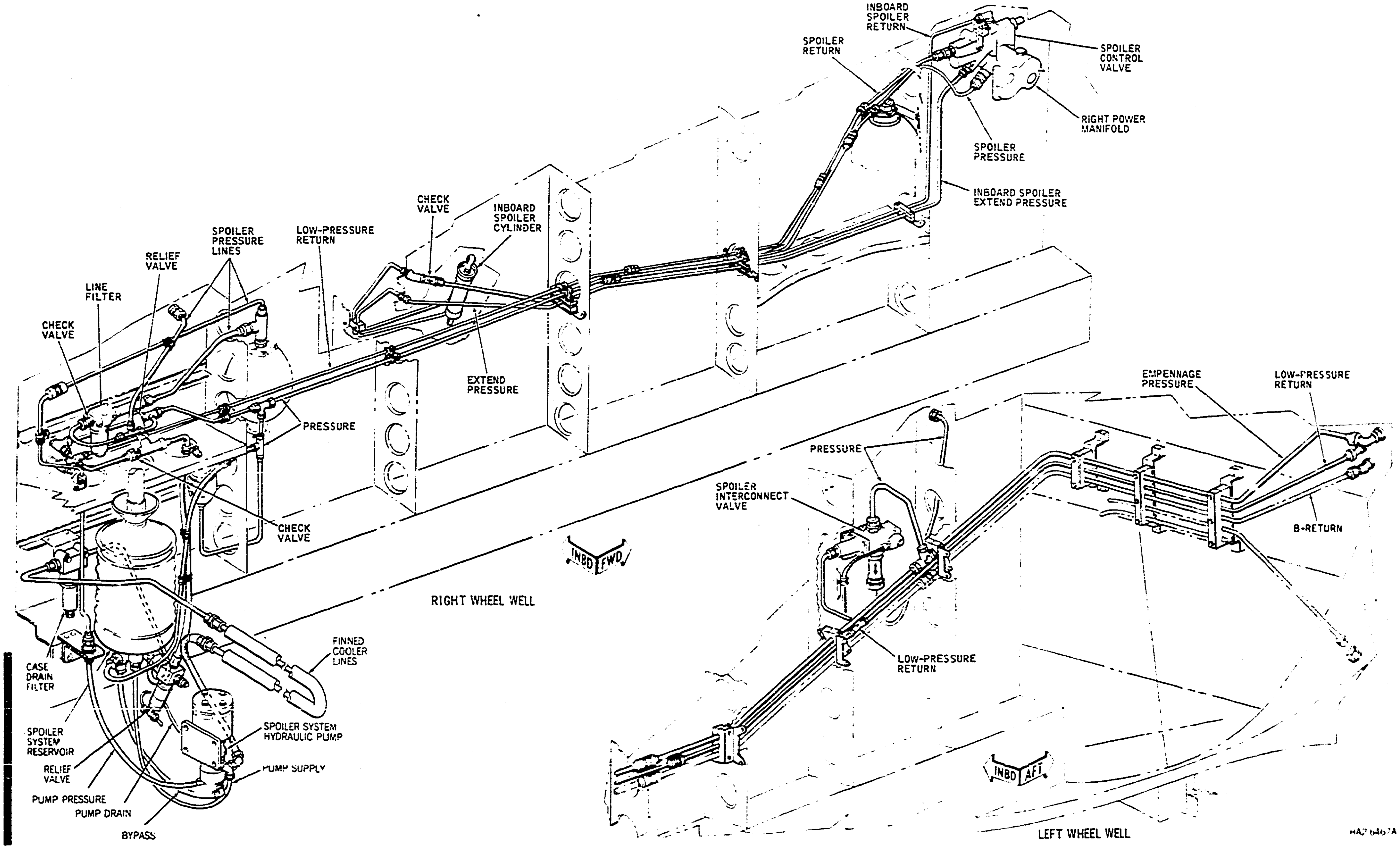
(5) At STA X_{rs} = approx. 217 on both sides of airplane, disconnect spoiler pressure and return lines from spoiler glands. Place jumpers between these lines on both sides of airplane.

(6) At tee in return bulkhead tee, located just under pressure bulkhead tee mentioned in Step (4), disconnect both lines which run forward. Cap tee and place jumper across two lines.

(7) Disconnect return line from check valve in tee at bottom of system pressure relief valve. Connect this line to line disconnected in Step (4) with jumper.

(8) At spoiler valve, located on right power manifold, disconnect spoiler return line. From same manifold, disconnect spoiler pressure line. Connect these two lines together with jumper.

(9) Connect jumper line to line which was disconnected in Step (3). In same line at next tee forward, disconnect line which leads down to pressure transmitter and reservoir. Cap tee and connect open line to other end of jumper.



Flushing Procedure Line Connection Locations
Figure 601

(10) Disconnect reservoir pressurization line from tee in pressure line. Disconnect pressure line from pressure transmitter. Connect two open lines with jumper, and cap tee.

(11) Disconnect reservoir pressurization line from bottom of reservoir, and connect line to test stand return hose.

(12) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(13) Flush circuit for five minutes.

(14) Depressurize test stand.

(15) Inspect, clean, and/or replace check valves in the filter, and in bottom of relief valve.

(16) Restore all lines and units to original configuration.

C. Outboard Spoiler System

(1) At STA X_{rs} = approx. 217, inspect, clean, and/or replace outboard spoiler cylinder and valve assembly, and connecting swivel glands.

(2) Restore all lines and units to their original configuration, and make any necessary adjustments per Chapter 27.

D. Inboard Spoiler System

(1) Disconnect extend and retract lines from spoiler control valve, located on right power manifold in right wheel well. Connect extend line to test stand pressure hose. Connect retract line to test stand return hose.

(2) On right side of the center web, replace restrictor in spoiler retract line with jumper.

(3) In rear of left wheel well, disconnect extend and retract lines from inboard spoiler cylinder. Place jumper across open lines.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Inspect, clean, and/or replace spoiler control valve, two restrictors, and actuating cylinder.

(8) Restore all lines and units to original configuration, and make necessary adjustments per Chapter 27.

E. The Interconnect System

(1) In right wheel well, disconnect interconnect line from tee in spoiler system pressure line, located near spoiler system filter. Connect this line to test stand return hose.

(2) In left wheel well, disconnect three lines leading into solenoid interconnect valve, mounted on center web. Leave check valve with solenoid valve.

(3) Connect jumper between line disconnected from check valve and line disconnected from pressure port.

(4) Disconnect solenoid valve low-pressure return line from tee in empennage low-pressure return line. Connect this line to test stand pressure hose.

(5) Disconnect solenoid valve pressure line from tee in empennage pressure line. Connect this line to disconnected case drain line in solenoid interconnect valve with jumper.

(6) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(7) Flush circuit for five minutes.

(8) Depressurize test stand.

(9) Inspect, clean, and/or replace solenoid interconnect valve, and check valve.

(10) Restore all lines and units to original configuration.

RUDDER STANDBY HYDRAULIC POWER SYSTEM - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the rudder standby hydraulic power system by flushing the system with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal of overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before and flushing procedures are performed, personnel should read and thoroughly understand Section 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedures.

3. Flush Rudder Standby Hydraulic Power System

A. Rudder Standby Power System To Filter

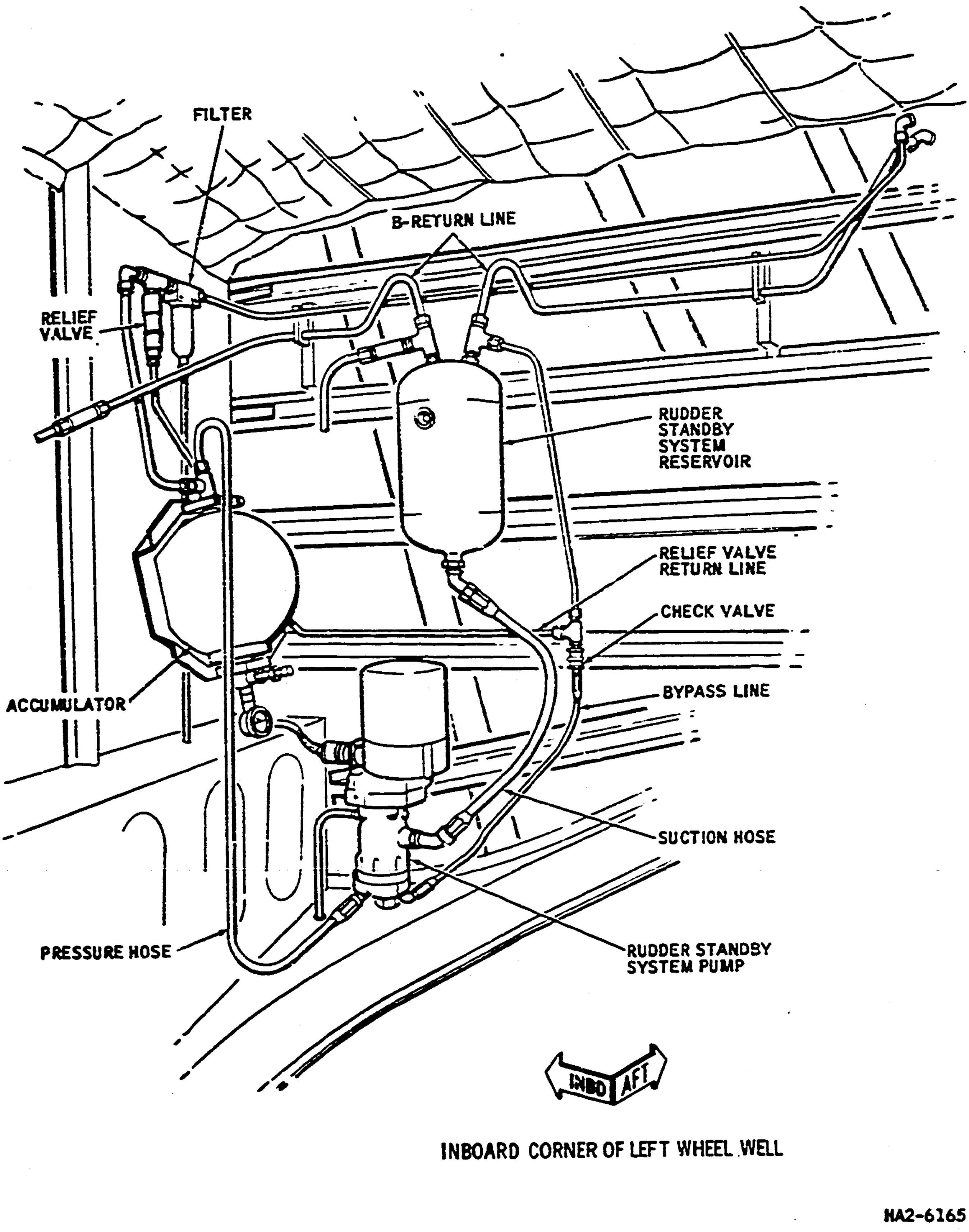
(1) In left wheel well, disconnect two B-return lines and bypass line from two tees in top of rudder standby system reservoir. Cap both openings in tee that had received bypass line.

(2) Connect opening in other tee to test stand pressure hose.

(3) Disconnect three hoses from rudder standby system pump. Connect suction hose to pressure hose.

(4) Disconnect 1/4-inch pressure line from tee in top of rudder standby system accumulator, and disconnect line in bottom of relief valve. Install jumper between these two lines.

(5) Disconnect relief valve return line and bypass line from tee fitting (with check valve). Use bypass hose as jumper between these two lines.



Flushing Procedure Line Connection Locations
Figure 601

(6) Connect bypass line, which was disconnected in Step (1), to test stand return hose.

(7) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(8) Flush circuit for five minutes.

(9) Depressurize test stand.

(10) Inspect, clean, and/or replace the pump, accumulator, filter, relief valve, and check valve.

(11) Restore all lines and units to original configuration.

B. Rudder Standby Power Interconnect Line (Filter To Empennage Normal Power Line)

(1) In left wheel well, disconnect rudder standby system pressure line from downstream side of filter. Connect this line to test stand pressure hose.

(2) In aft end of the airplane, disconnect rudder standby pressure line from check valve in tee located in normal rudder pressure line.

(3) This line may be attached directly to test stand return with long hose, or section of empennage return line may be connected into circuit for use with shorter test stand return hose.

(4) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(5) Flush circuit for five minutes.

(6) Depressurize test stand.

(7) Inspect, clean, and/or replace check valve mentioned in Step (2).

(8) Restore all lines and units to original configuration.

THRUST REVERSER SYSTEM - INSPECTION/CHECK

1. General

A. The purpose of this section is to provide a logical guide for removing the contaminates (foreign particles) from the fluid, units, and lines of the thrust reverser system by flushing the system with clean hydraulic fluid.

B. This procedure may be deviated from as dictated by the individual circumstances. Hydraulic circuits that are easy to locate and follow, have been intentionally omitted from this procedure for the sake of brevity.

C. The removal overheated or diluted fluid, would follow generally the same procedure with the exception that the removed contaminated fluid would be caught in containers rather than recirculated through the hydraulic test stand.

D. Before any flushing procedures are performed, personnel should read and thoroughly understand Section 29-00, Inspection/Check.

2. Tools and Equipment Required

A. One hydraulic test stand capable of operating with Skydrol hydraulic fluid, and fitted with a 10-micron or smaller filter.

B. Pressure and return hoses, jumper lines, and fittings as required by the following procedure.

3. Flush Thrust Reverser System

A. Thrust Reverser Pressure and Return Lines to Actuator Cylinders

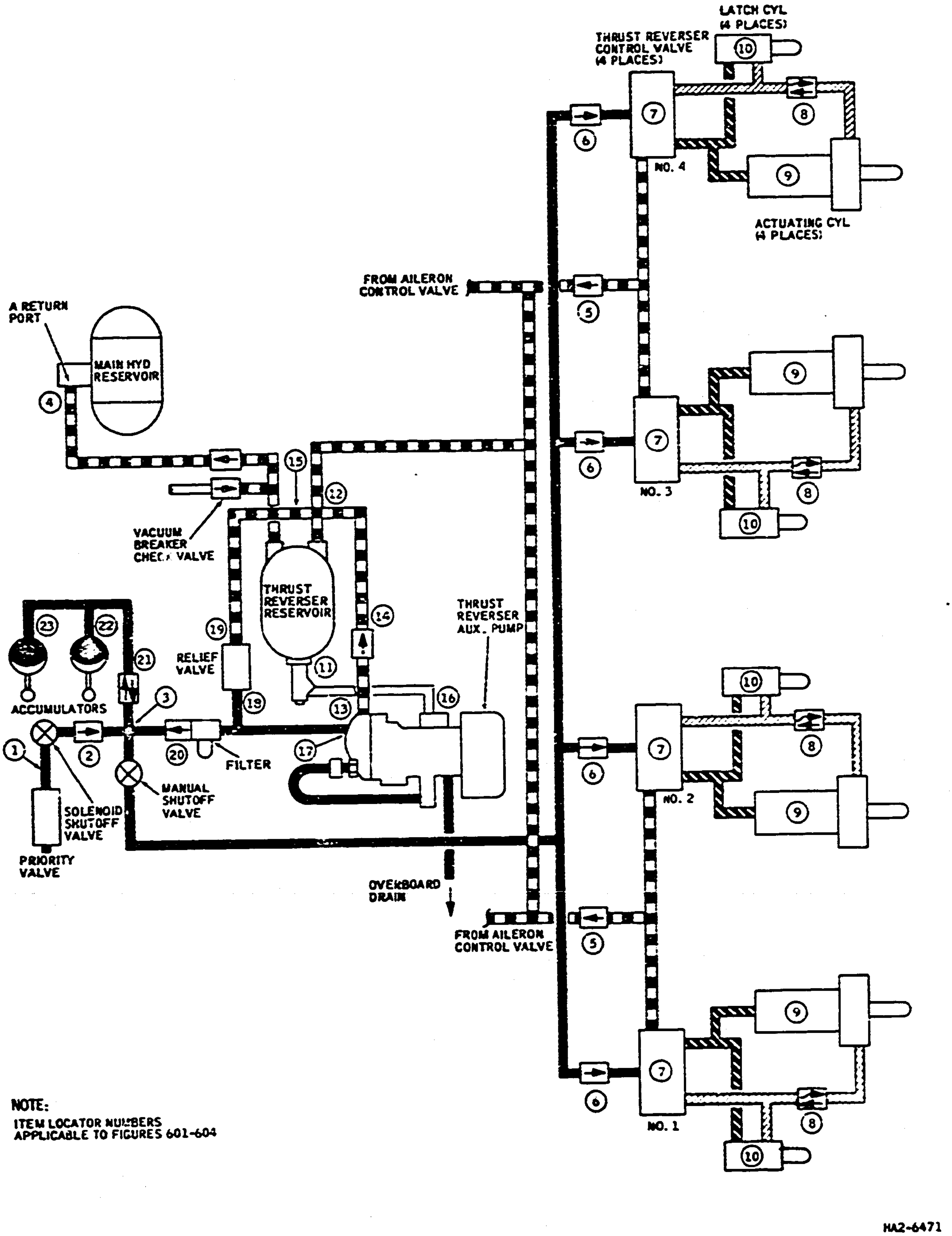
(1) Disconnect thrust reverser pressure line from cross fitting or tee (as applicable) below priority valve in left main gear wheel well. Cap fitting and connect test stand pressure hose to reverser pressure line.

(2) Disconnect inlet and outlet lines from thrust reverser solenoid valve and check valve located below priority valve. Jumper lines and make certain that manual shutoff valve is open.

(3) At cross fitting just aft of manual shutoff valve, disconnect auxiliary pump pressure line and accumulator pressure line. Cap cross fitting ports.

(4) Drain main hydraulic reservoir to a point below return ports manifold. (See 29-00, Maintenance Practices).

(5) At main hydraulic reservoir, disconnect A return line from tee fitting above auxiliary pump relief valve.



Flushing Procedure Line Connection Locations
Figure 601

(6) Connect test stand return hose to A return line.

(7) Disconnect and jumper check valve in A return line adjacent to thrust reverser reservoir in left wing root area.

NOTE: The thrust reverser pressure and return lines follow the rear spar outboard from the fuselage to the number 2 and number 3 pylons, and then forward within the pylons, to the front spar where the lines are teed and follow the front spar to the number 1 and number 4 pylons.

(8) Aft of rear spar at number 2 pylon, remove and jumper thrust reverser return line check valve.

(9) In number 1 pylon, remove and jumper pressure line check valve located above thrust reverser latch cylinder.

(10) Disconnect four lines from thrust reverser control valve.

(11) Jumper thrust reverser pressure line to thrust reverser stow line and thrust reverser return line to thrust reverser extend line.

(12) Remove and jumper restrictor in actuator cylinder stow line.

(13) Disconnect and jumper extend and stow lines to thrust reverser actuator cylinder.

(14) Disconnect and jumper extend and stow lines to thrust reverser latch cylinder.

(15) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(16) Flush circuit for five minutes.

(17) Depressurize test stand.

(18) Inspect, clean, and/or replace thrust reverser control valve, actuating cylinder, latch cylinder, pylon pressure line check valve, and stow line restrictor.

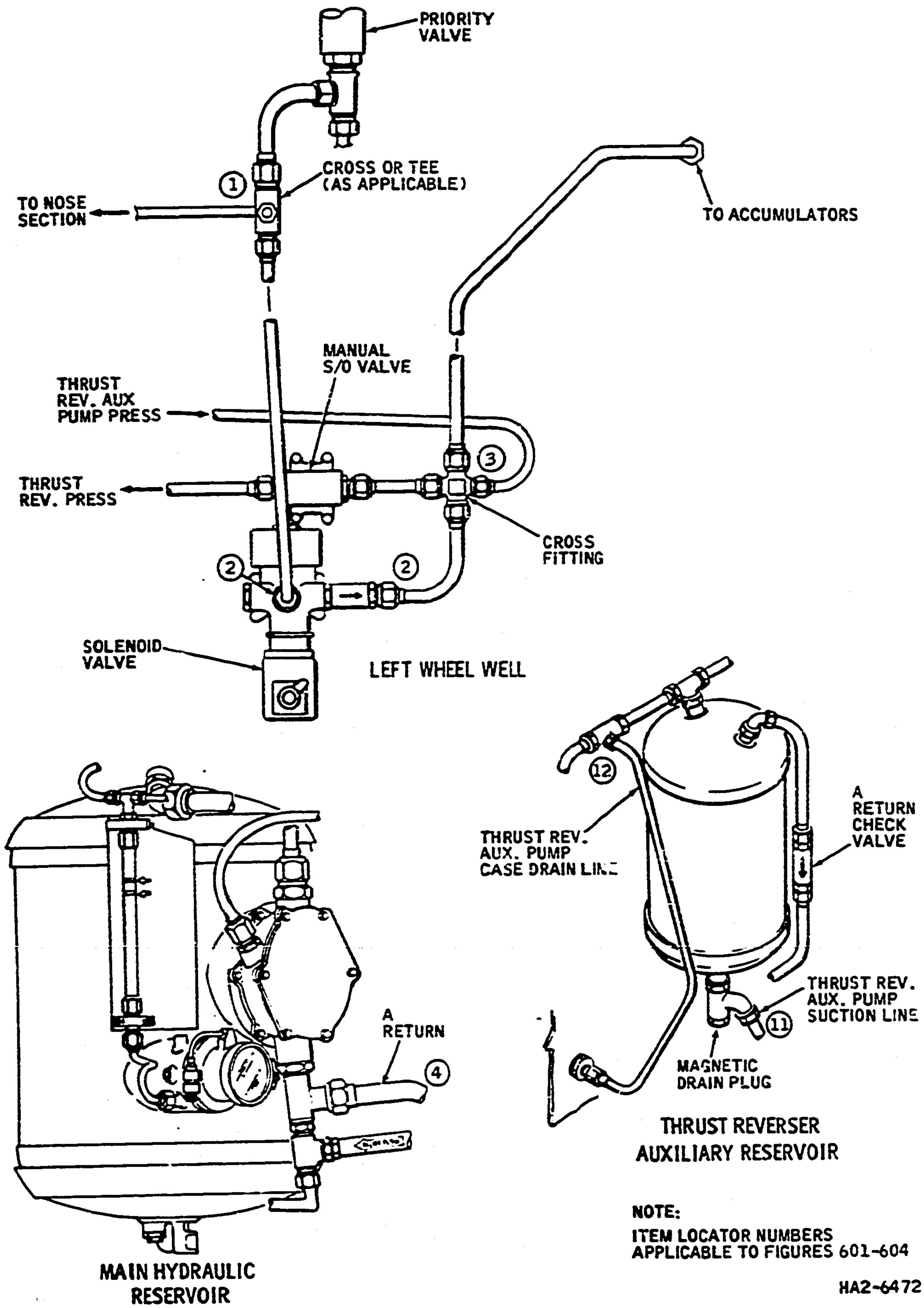
(19) Restore all lines and units in number one pylon to original configuration.

(20) Repeat steps (9) through (19) for number 2 pylon.

(21) Inspect, clean, and/or replace return line check valve aft of number 2 pylon.

(22) Aft of rear spar at number 3 pylon, remove and jumper thrust reverser return line check valve.

(23) Repeat steps (9) through (19) for number 4 pylon.



Flushing Procedure Line Connection Locations
Figure 602

(24) Repeat steps (9) through (19) for number 3 pylon.

(25) Inspect, clean, and/or replace return line check valve aft of number 3 pylon, thrust reverser solenoid valve, pressure line check valve at solenoid valve outlet, and A return line check valve.

(26) Restore all lines and units to original configuration except cross fitting disconnected in step (3).

B. Thrust Reverser Auxiliary Pump and Accumulator Lines

(1) Remove magnetic drain plug from thrust reverser reservoir and drain reservoir. Clean plug, reinstall and safety with lock wire (see Chapter 78).

(2) Disconnect thrust reverser auxiliary pump suction line from bottom of thrust reverser auxiliary reservoir.

(3) Disconnect pump case drain line at tee near top of auxiliary reservoir.

(4) Jumper case drain line to suction line.

(5) At thrust reverser auxiliary pump, disconnect case drain hose.

(6) Connect test stand pressure hose to case drain hose.

(7) Disconnect, remove, and jumper case drain check valve located at outboard end of case drain hose.

(8) Disconnect relief valve return line at tee at outboard end of case drain hose. Cap tee.

(9) Disconnect auxiliary pump suction hose at pump and connect test stand return hose to suction hose.

(10) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(11) Flush circuit for five minutes.

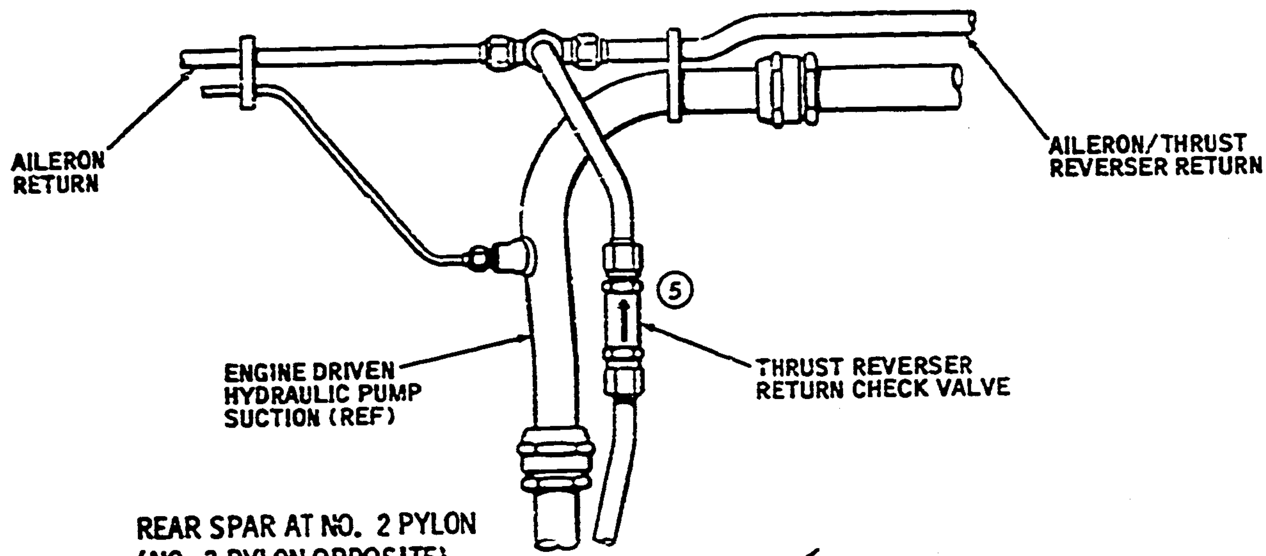
(12) Depressurize test stand.

(13) Disconnect test stand pressure hose from case drain hose.

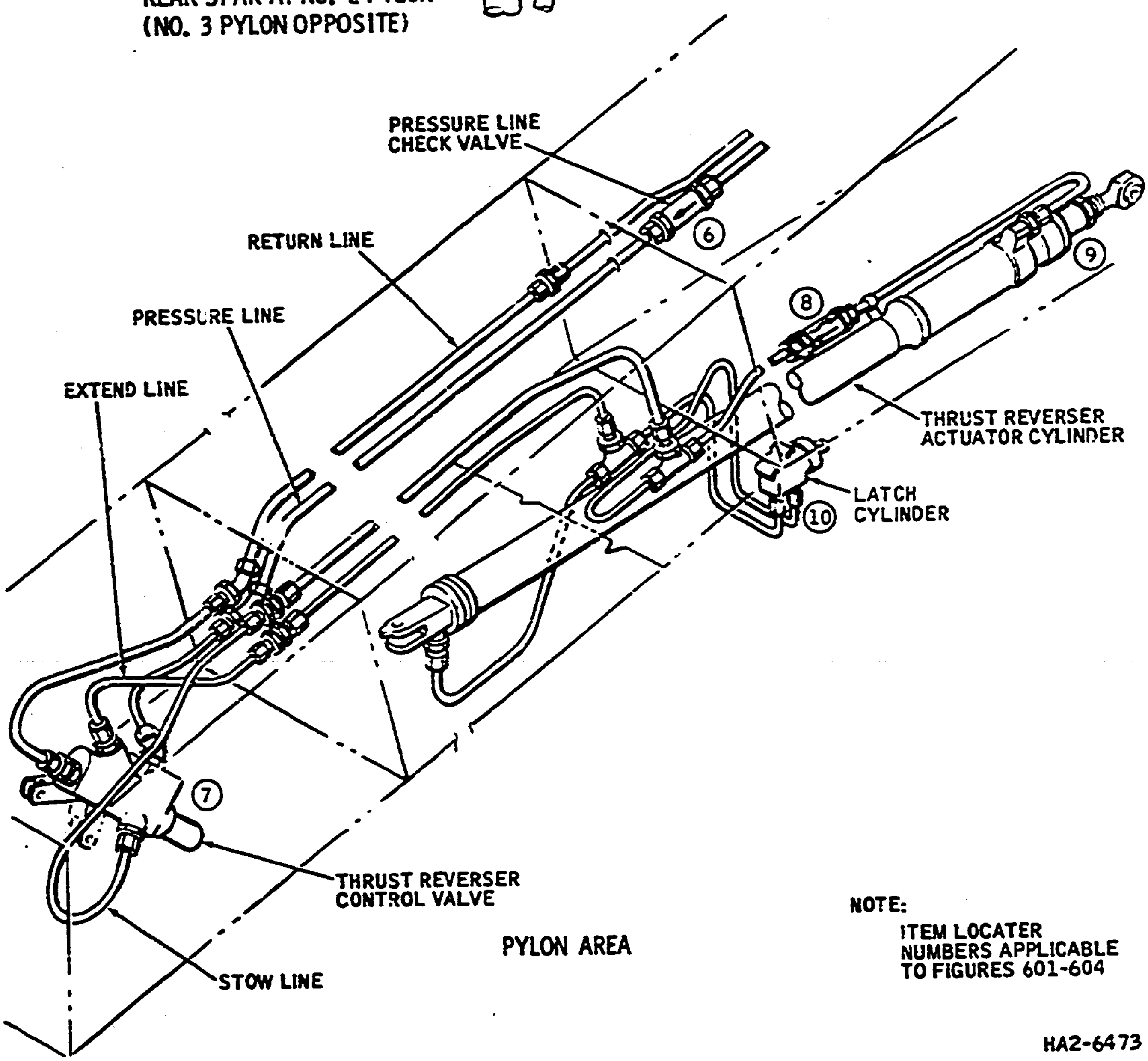
(14) Disconnect auxiliary pump pressure hose from pump and connect test stand pressure hose to auxiliary pump pressure hose.

(15) Disconnect downstream end of auxiliary pump pressure hose from relief valve manifold.

(16) Disconnect relief valve return line from bottom of relief valve and jumper to pressure hose disconnected in step (15).



REAR SPAR AT NO. 2 PYLON
(NO. 3 PYLON OPPOSITE)



PYLON AREA

NOTE:
ITEM LOCATER NUMBERS APPLICABLE TO FIGURES 601-604

HA2-6473

Flushing Procedure Line Connection Locations
Figure 603

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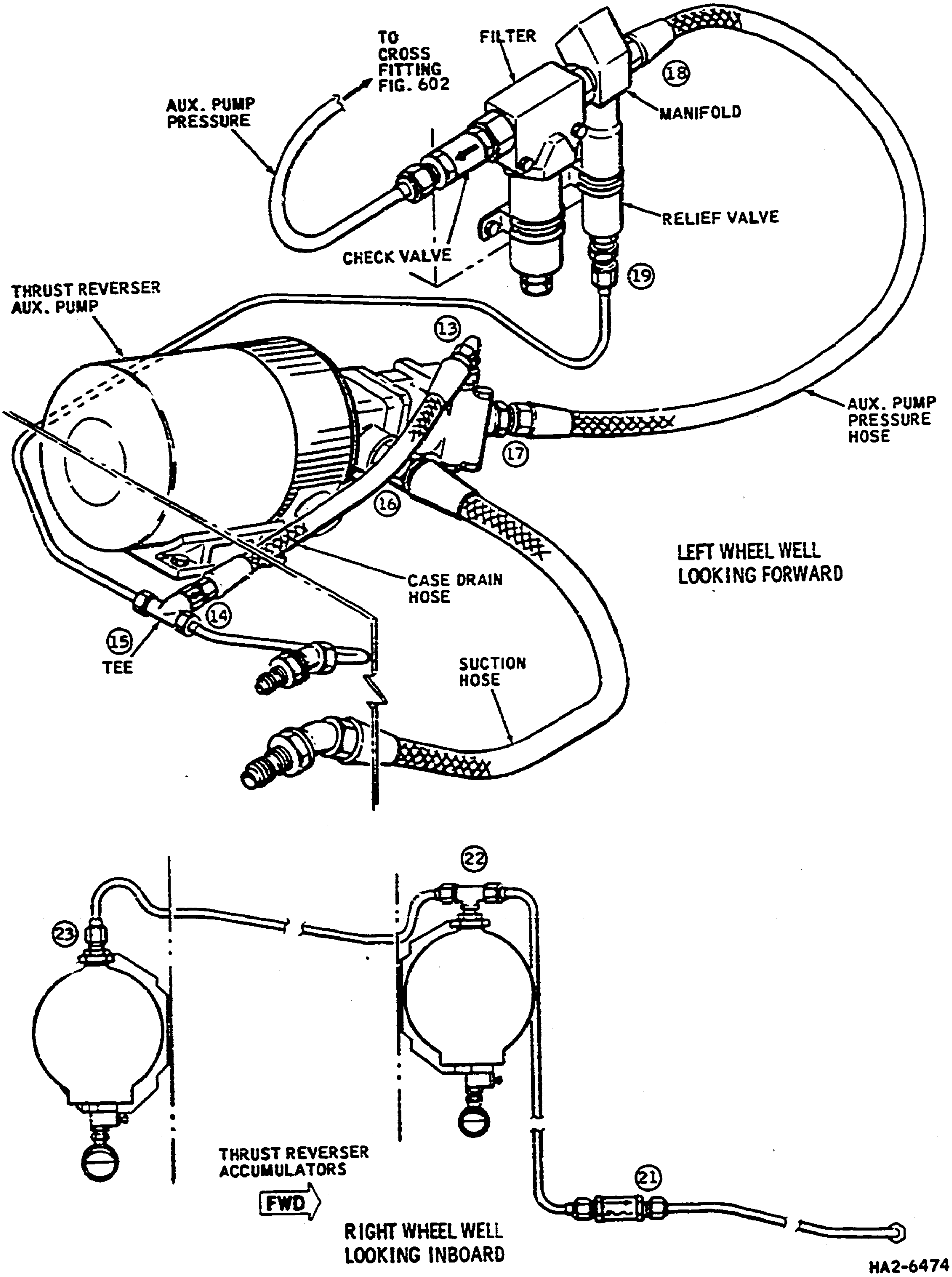

Flushing Procedure Line Connection Locations
Figure 604

(17) Disconnect pump pressure line from outlet check valve on auxiliary pump filter. Jumper this line to open end of relief return line disconnected in step (8).

(18) Connect test stand return hose to auxiliary pump pressure line disconnected from cross fitting in step A(3).

(19) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(20) Flush circuit for five minutes.

(21) Depressurize test stand.

(22) Disconnect test stand return hose from auxiliary pump pressure line at cross fitting and connect return hose to thrust reverser accumulator line disconnected in step A(3).

(23) In right main gear wheel well, disconnect and jumper restrictor located in thrust reverser pressure line just below and forward of thrust reverser accumulators.

(24) Disconnect and jumper pressure lines at tee on forward accumulator.

(25) Disconnect pressure line from aft accumulator.

(26) Disconnect test stand pressure hose from auxiliary pump pressure hose in left wheel well and connect to accumulator pressure at aft accumulator.

(27) Pressurize test stand to 200 psi maximum at 20 gpm flow.

(28) Flush circuit for five minutes.

(29) Depressurize test stand.

(30) Inspect, clean and/or replace thrust reverser auxiliary pump, filter, relief valve, check valves, restrictor, and accumulators.

(31) Restore all lines and units to original configuration.

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MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

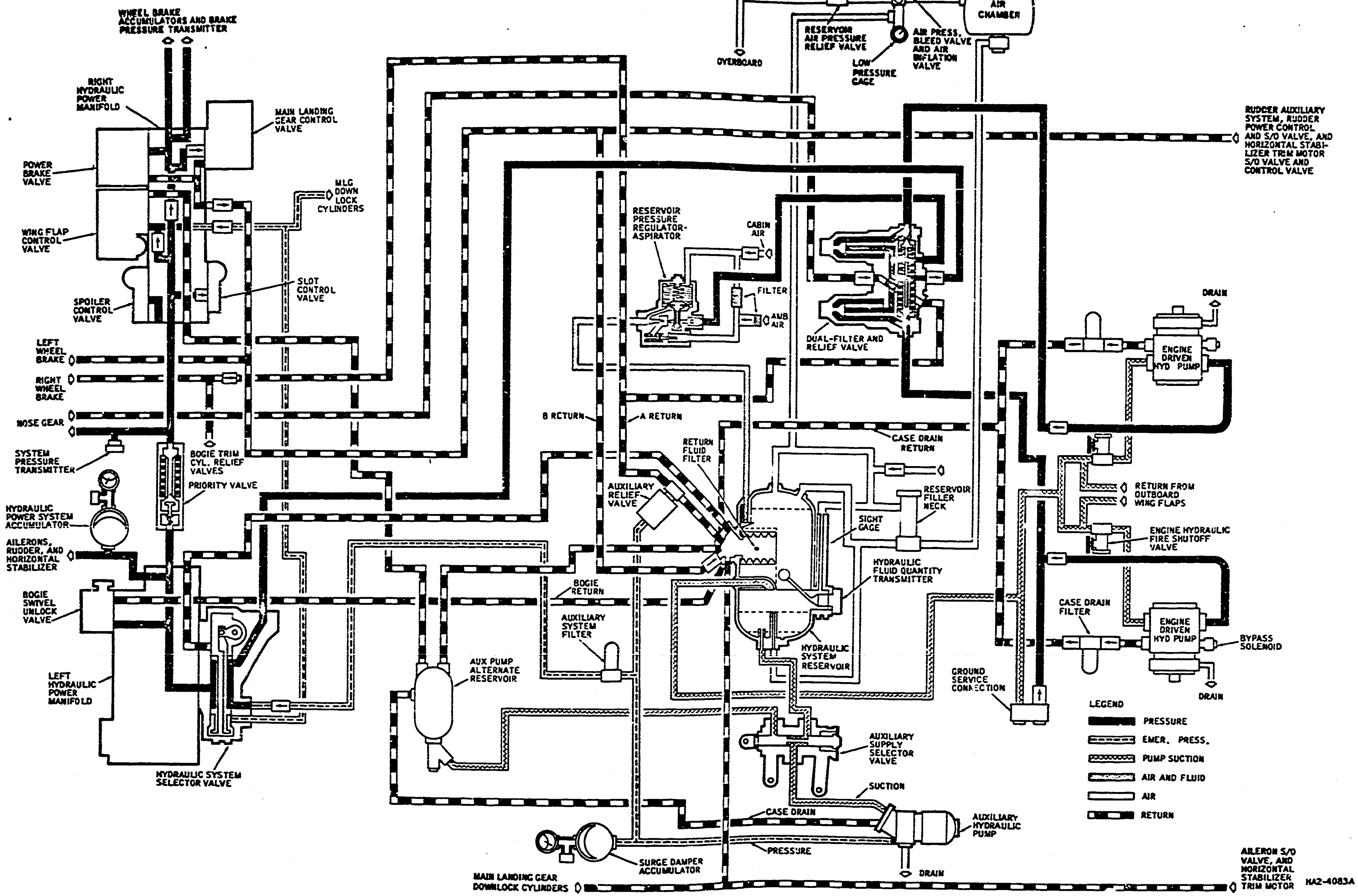
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.



Hydraulic Power System -- Schematic Diagram
(Airplanes N8070U-N8075U)
Figure 1 (Sheet 1)

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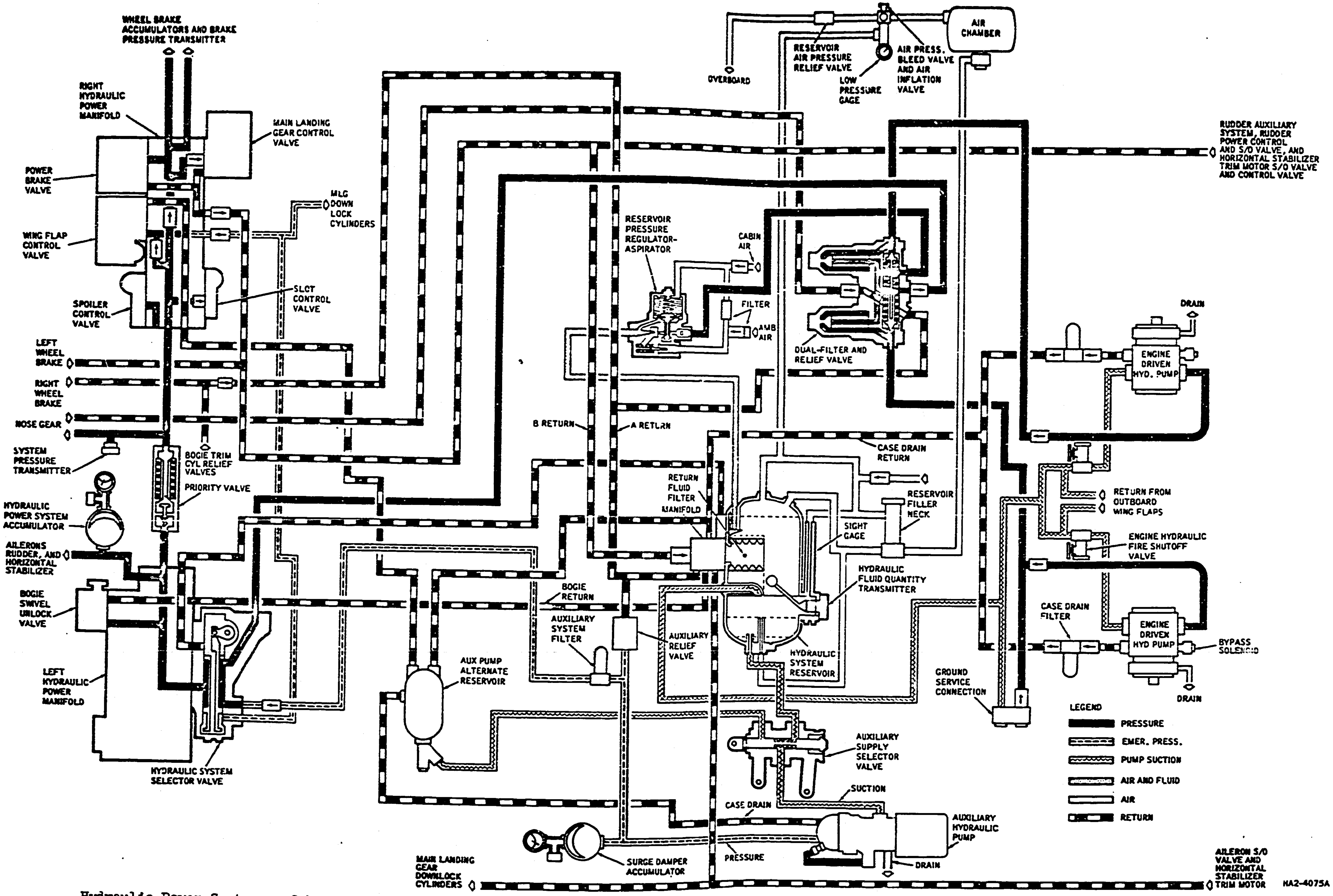
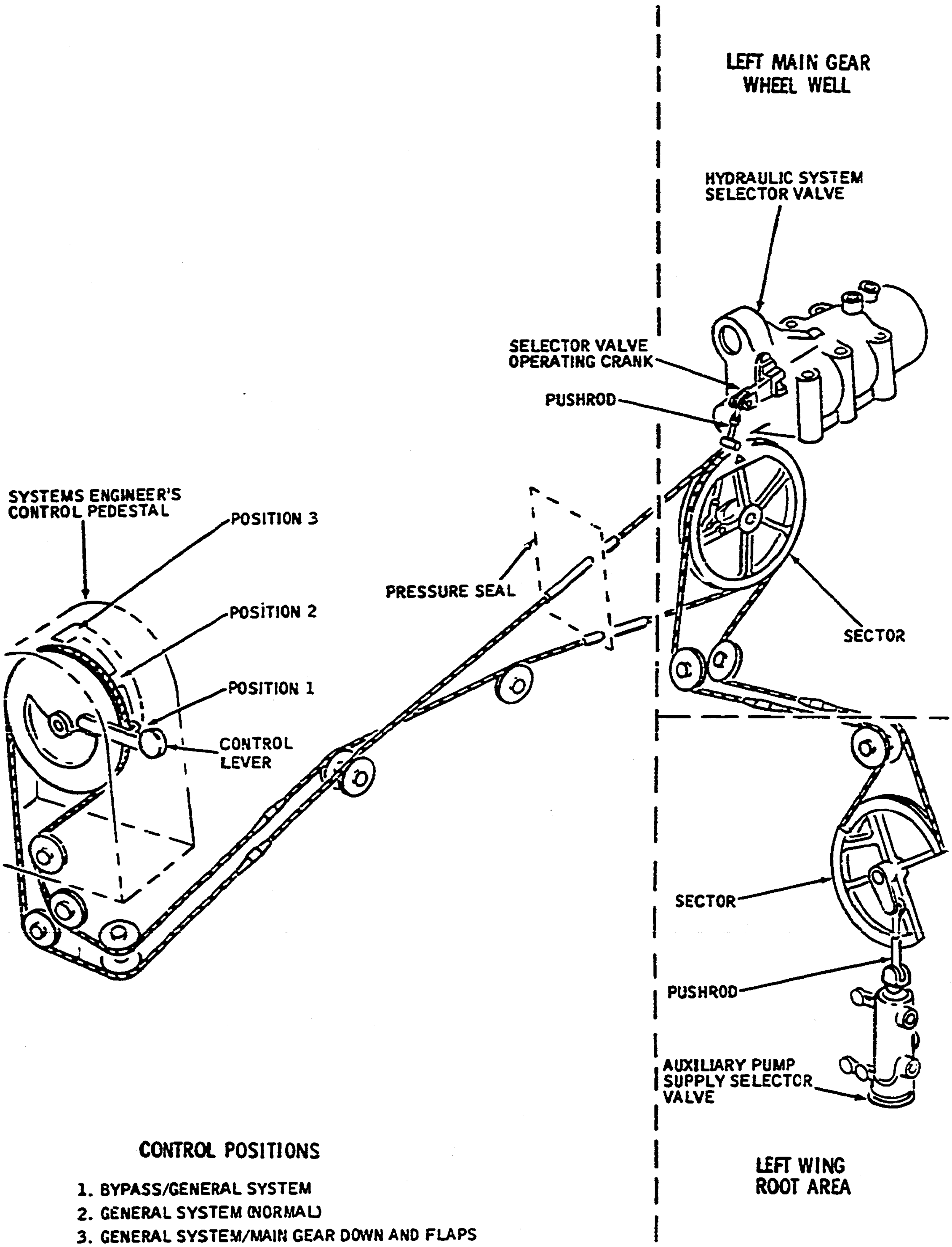


Hydraulic Power System -- Schematic Diagram
(Airplanes N8076-N8099)
Figure 1 (Sheet 2)



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff.

(6) ..e right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake.

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines fo- each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

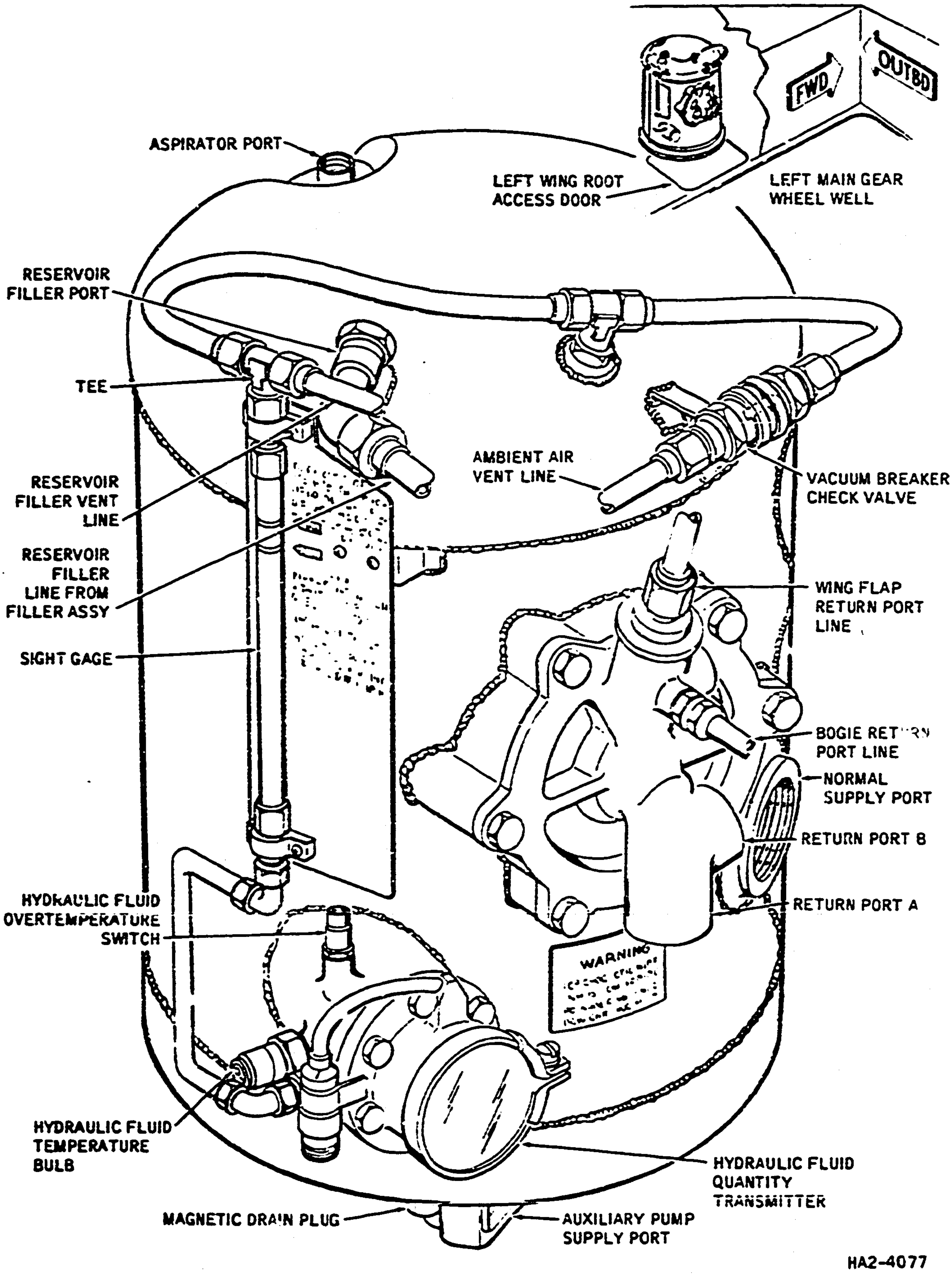
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior



Hydraulic System Reservoir -- External View
(Airplanes N8070U-N8075U)
Figure 3 (Sheet 1)

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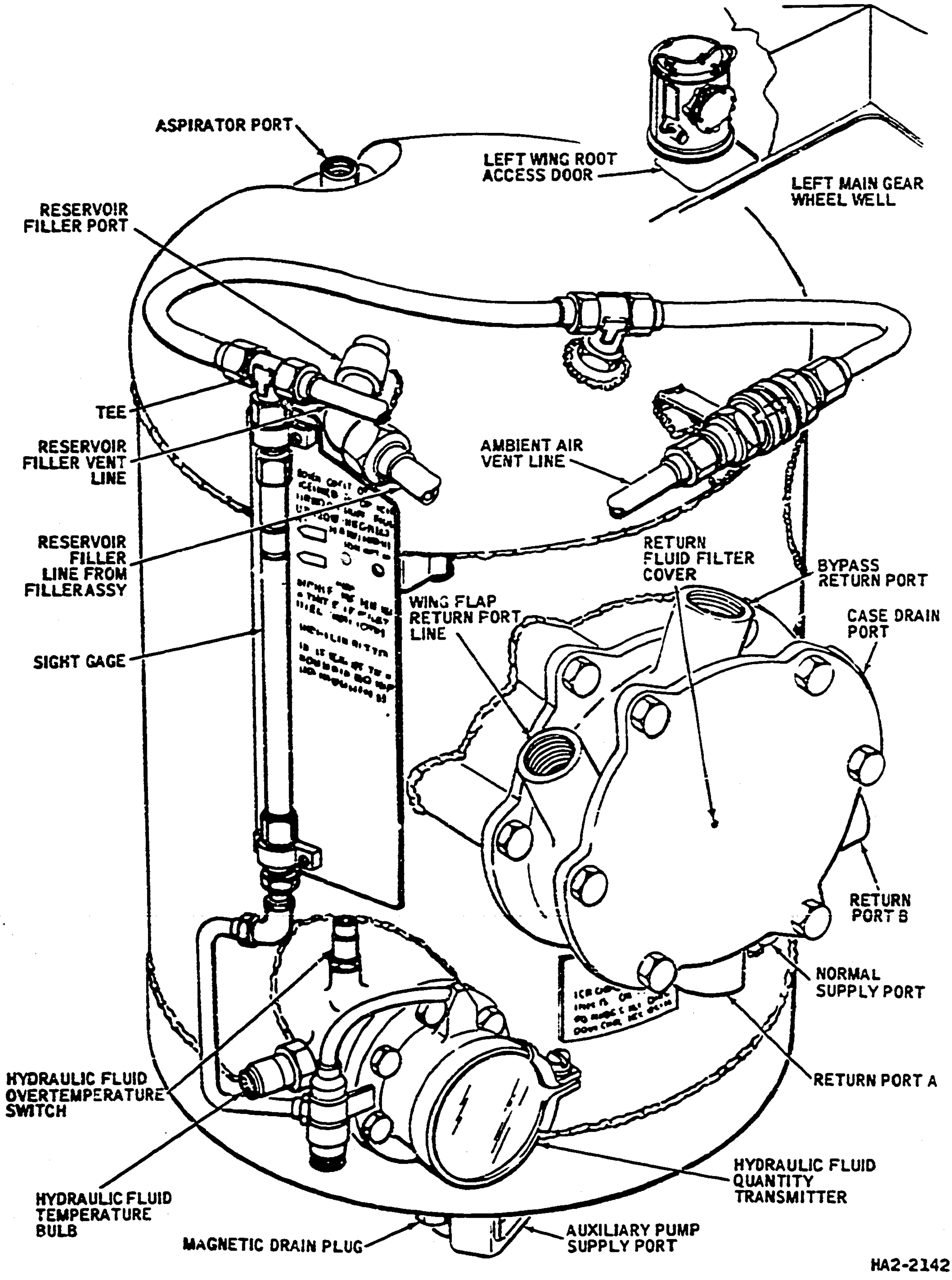
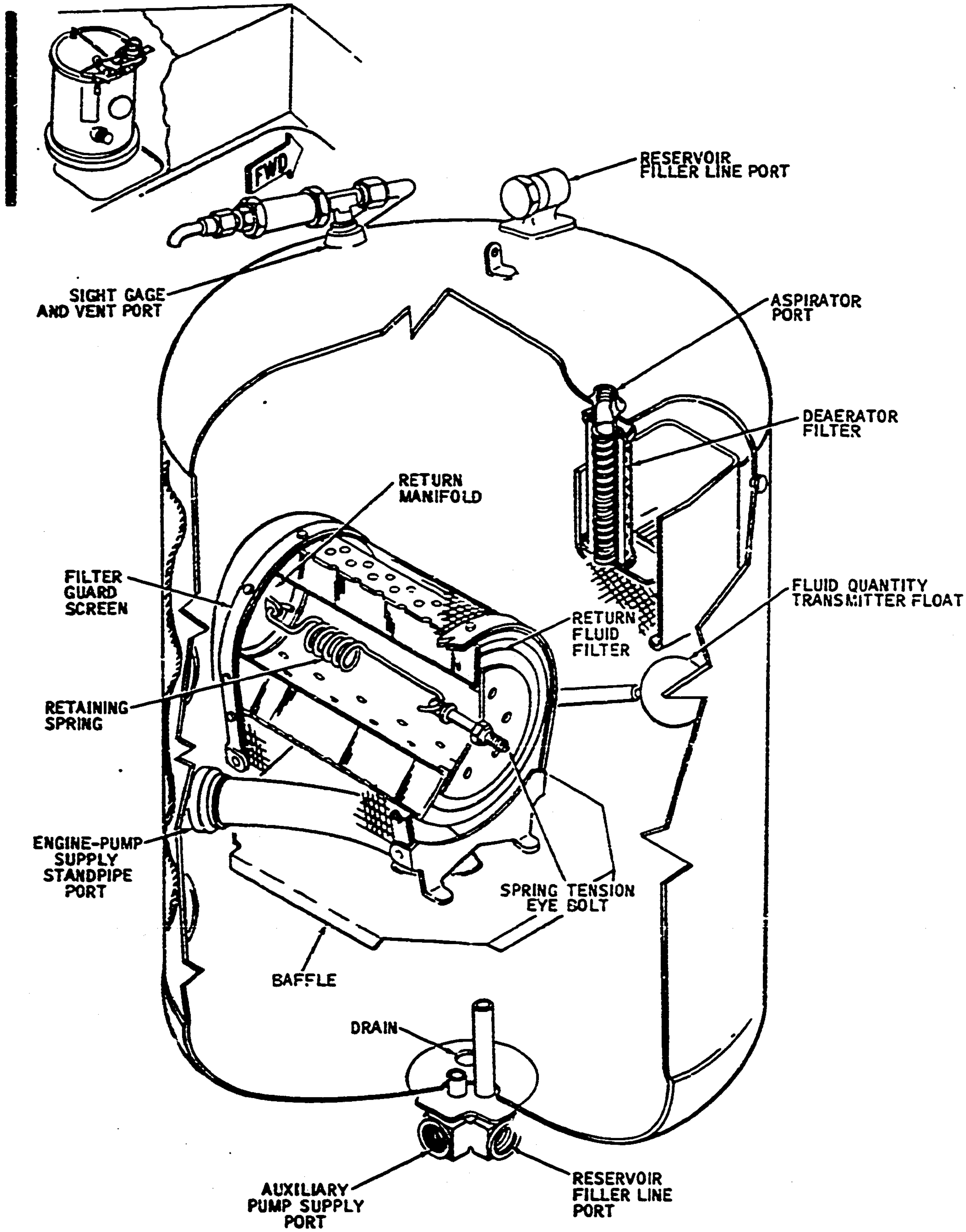


Hydraulic System Reservoir -- External View
(Airplanes N8076U-N8099U)
Figure 3 (Sheet 2)



Hydraulic System Reservoir -- Cutaway View
Figure 4

surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) On airplanes N8070U-N8075U, the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The manifold is bolted to the flange and contains five ports: return port A, located at the bottom; return port B, located at the lower right side; the low-pressure return port, located at the upper right; the wing flap return port, located at the top; and the bogie return port, located on the face of the manifold just below the wing flap return port.

(5) On airplanes N8070U-N0875U, the return fluid filter is installed in the reservoir behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the manifold holds the filter in position. A baffle plate is welded to the inside of the reservoir and to the engine pump supply standpipe within the reservoir. A screen, which reduces aeration of the fluid, is snap-mounted to two brackets which are welded to the baffle. The screen is U-shaped and is mounted so that it will enclose the filter.

(6) On airplanes N8076U-N8099U, the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the other manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(7) On airplanes N8076U-N8099U, the return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(8) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage, and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) On airplanes N8070U-N8075U, the reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold and is spring loaded to act as its own relief valve. Access to the filter is by removing the return ports manifold. Removal of the return ports manifold necessitates disconnecting the return lines from the manifold and removal of six bolts which secure the manifild to the reservoir. The filter which is attached to the manifold is then withdrawn from the reservoir.

(1a) On airplanes N8076U-N8099U, the reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

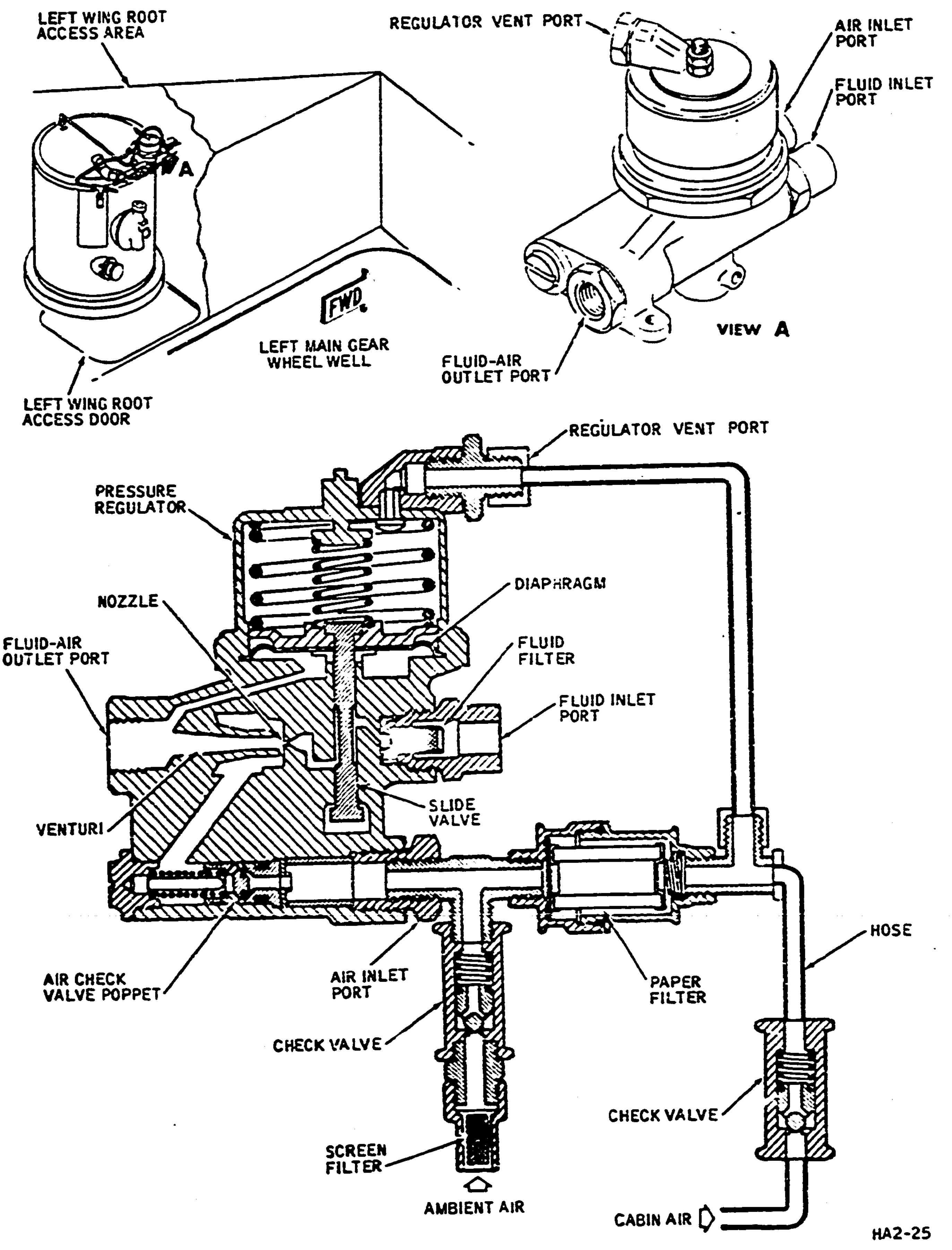
(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.



Reservoir Air Pressure
Regulator-Aspirator -- Schematic
Figure 5

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

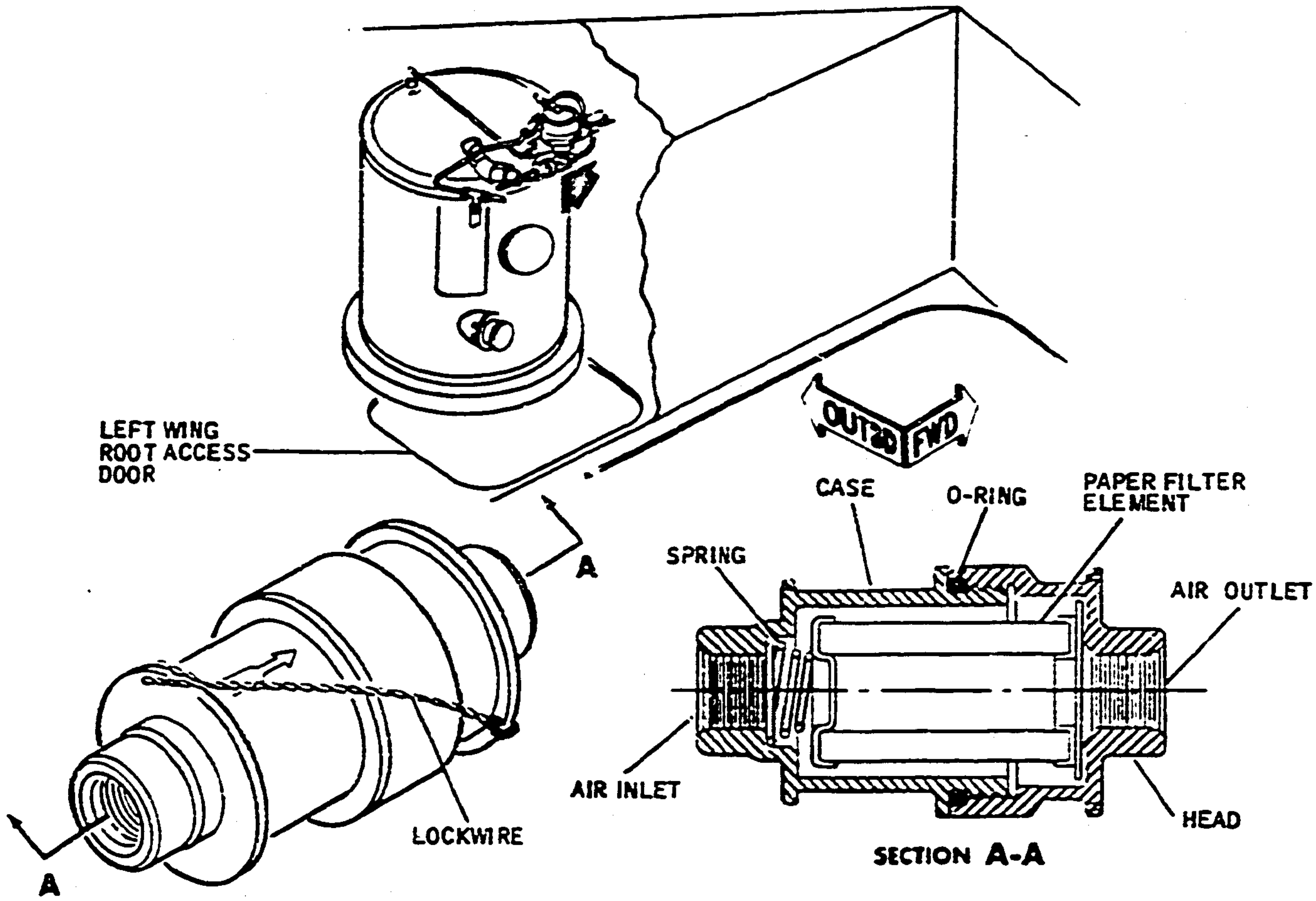
D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

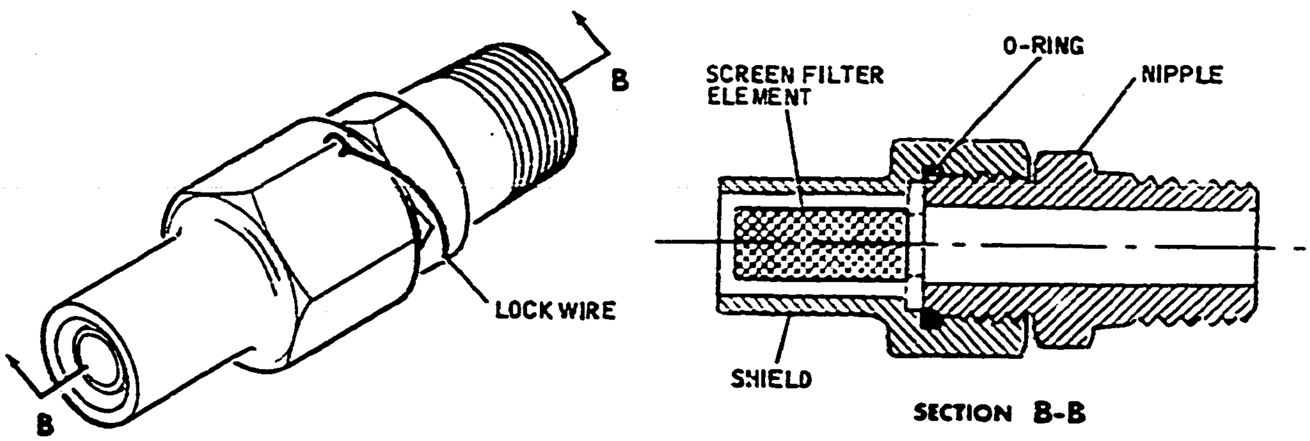
E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at



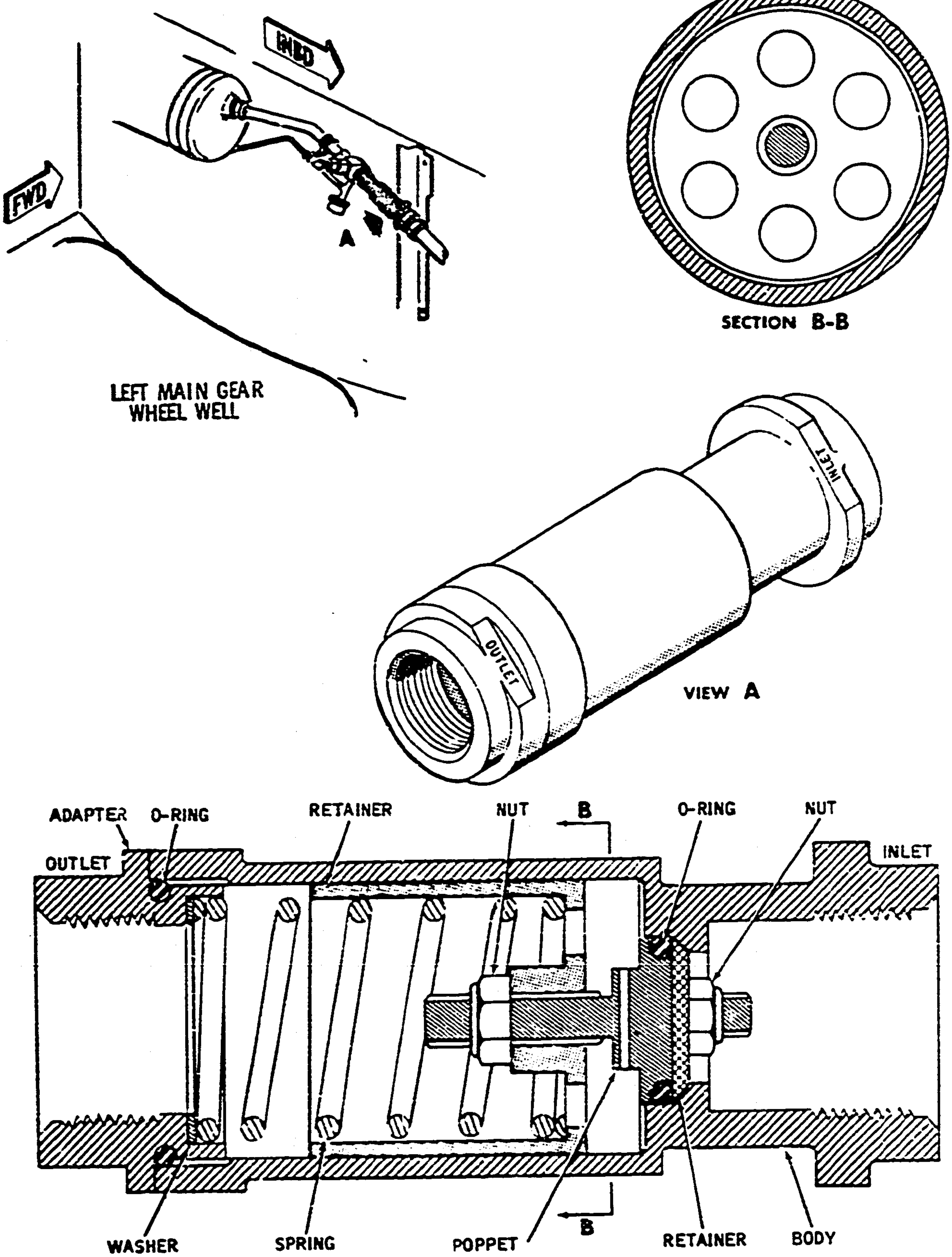
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters --
Cutaway View
Figure 6



HA2-17

Hydraulic Reservoir Relief Valve
Figure 7

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45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

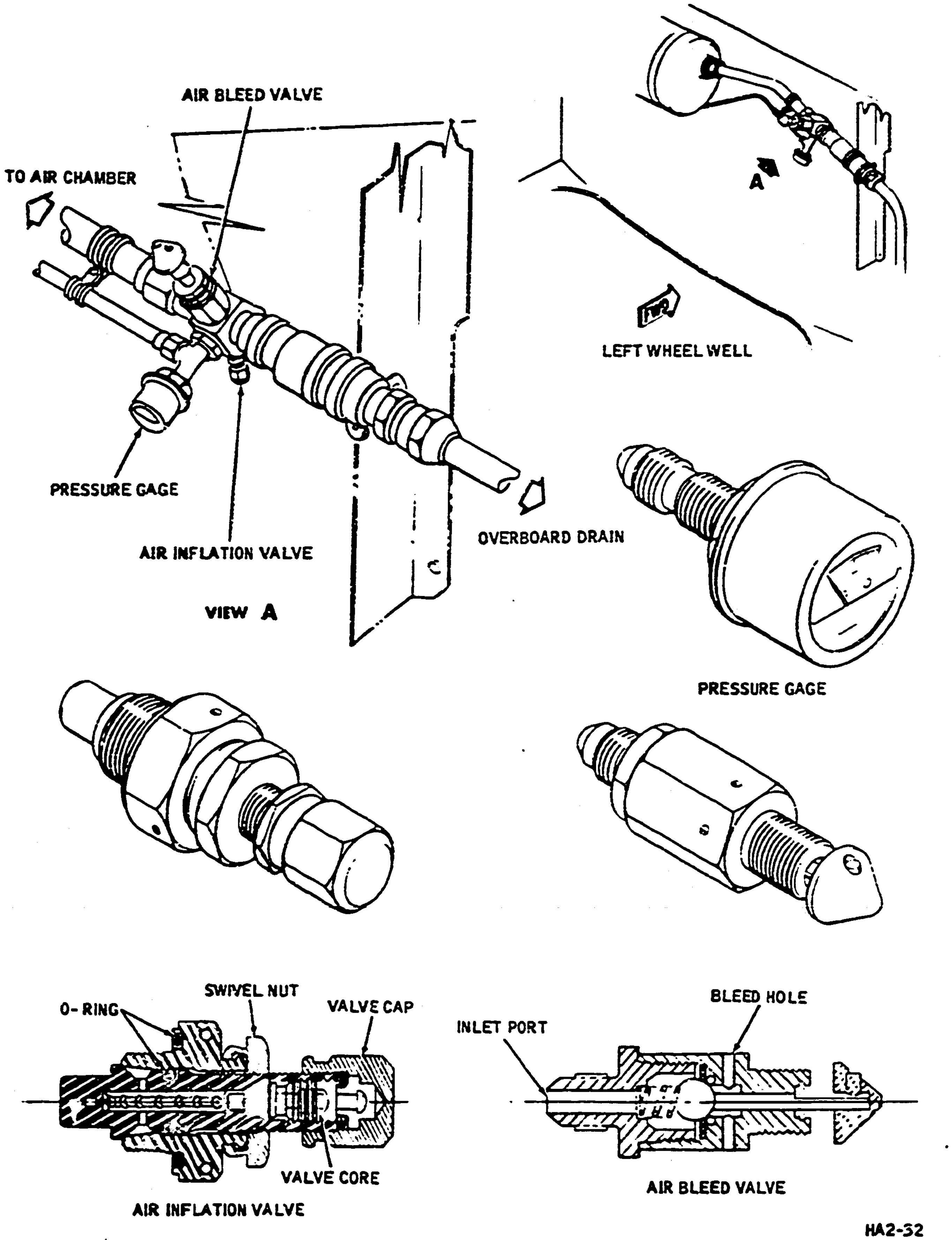
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

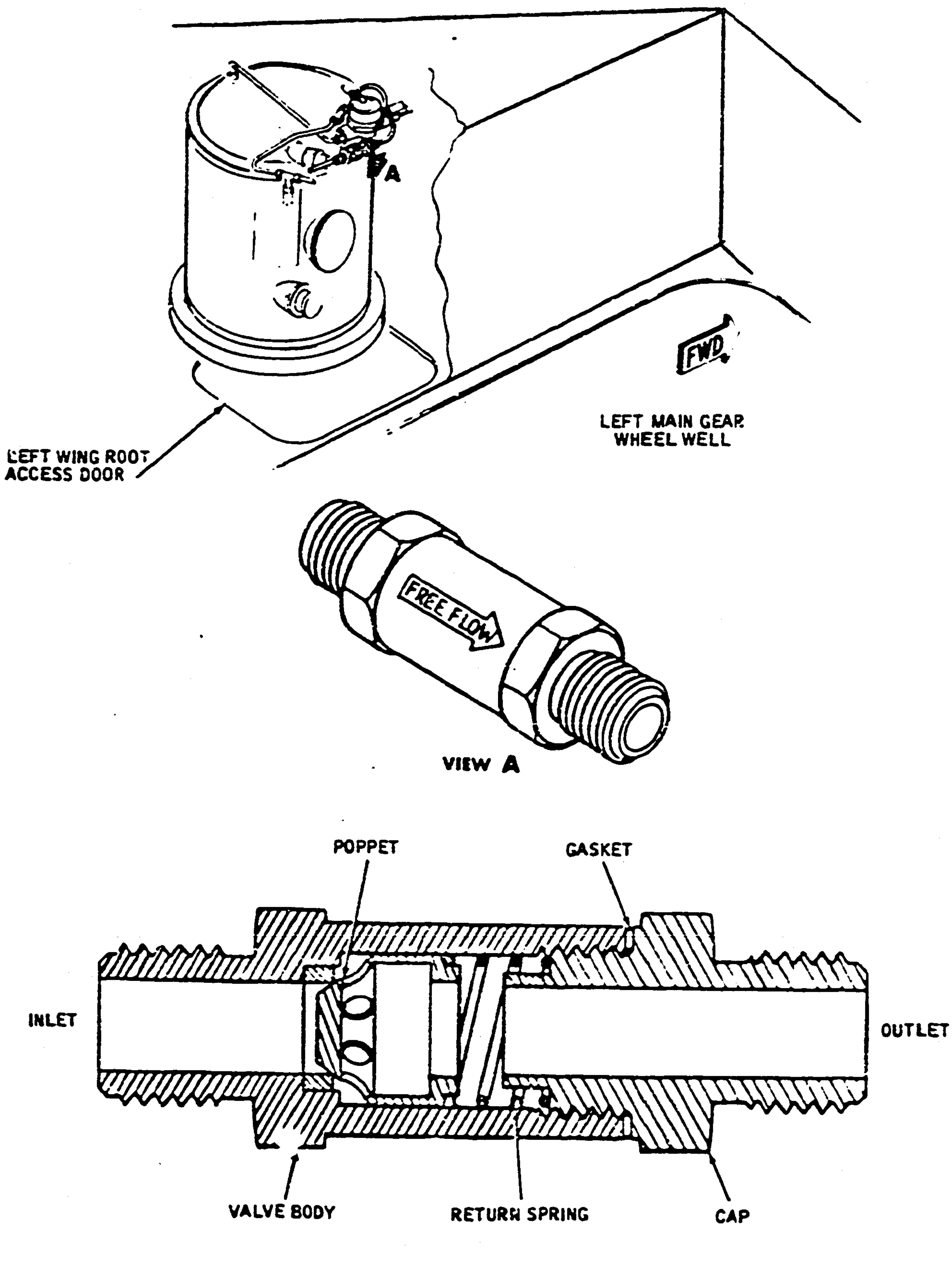
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



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Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two position-in grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is

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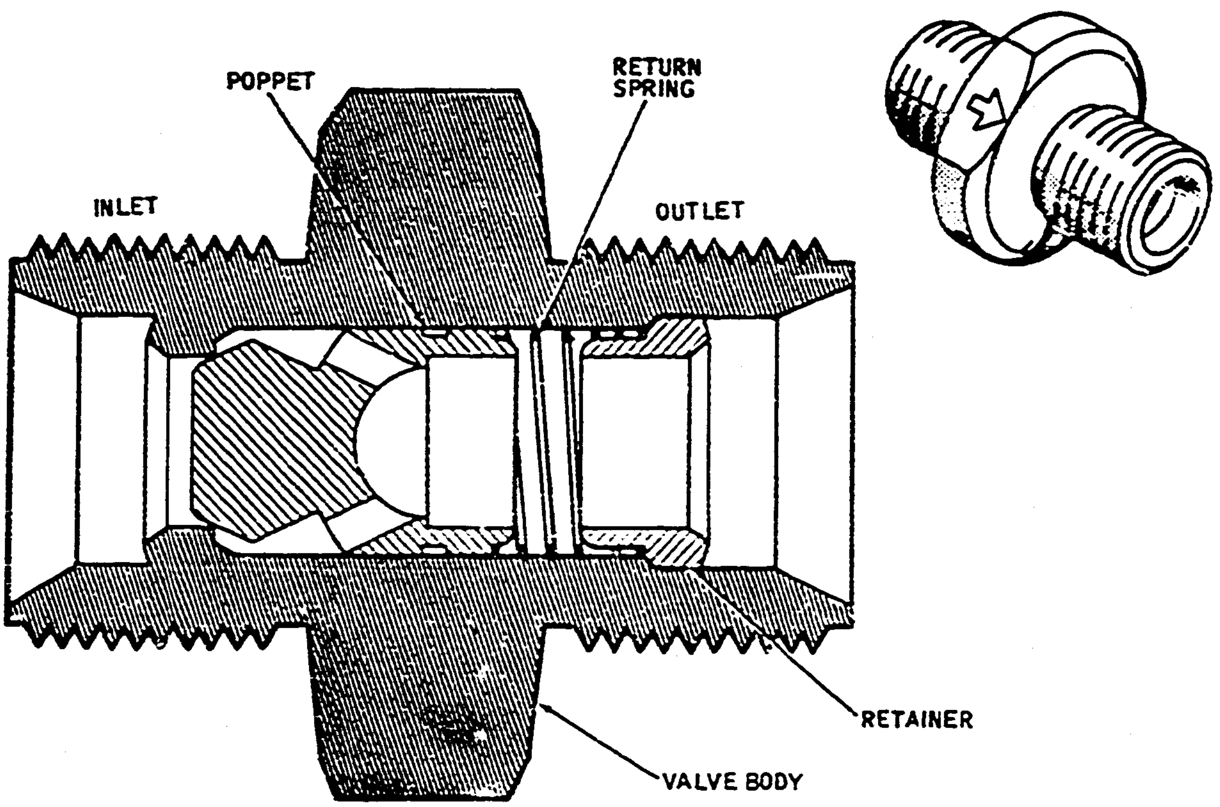
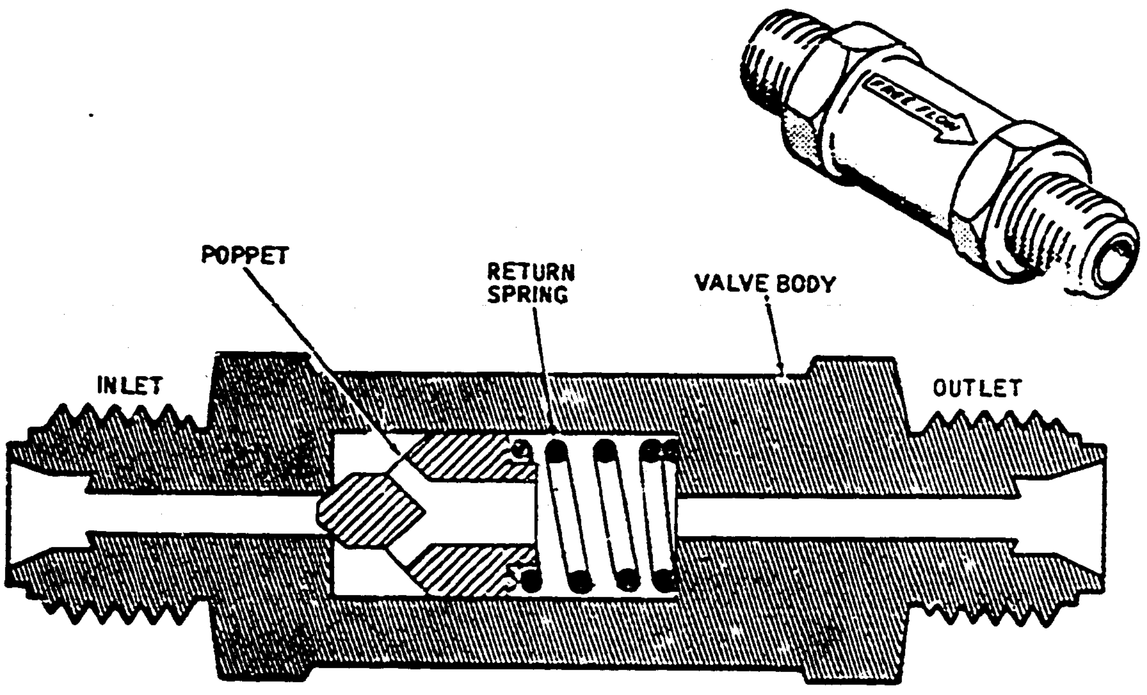


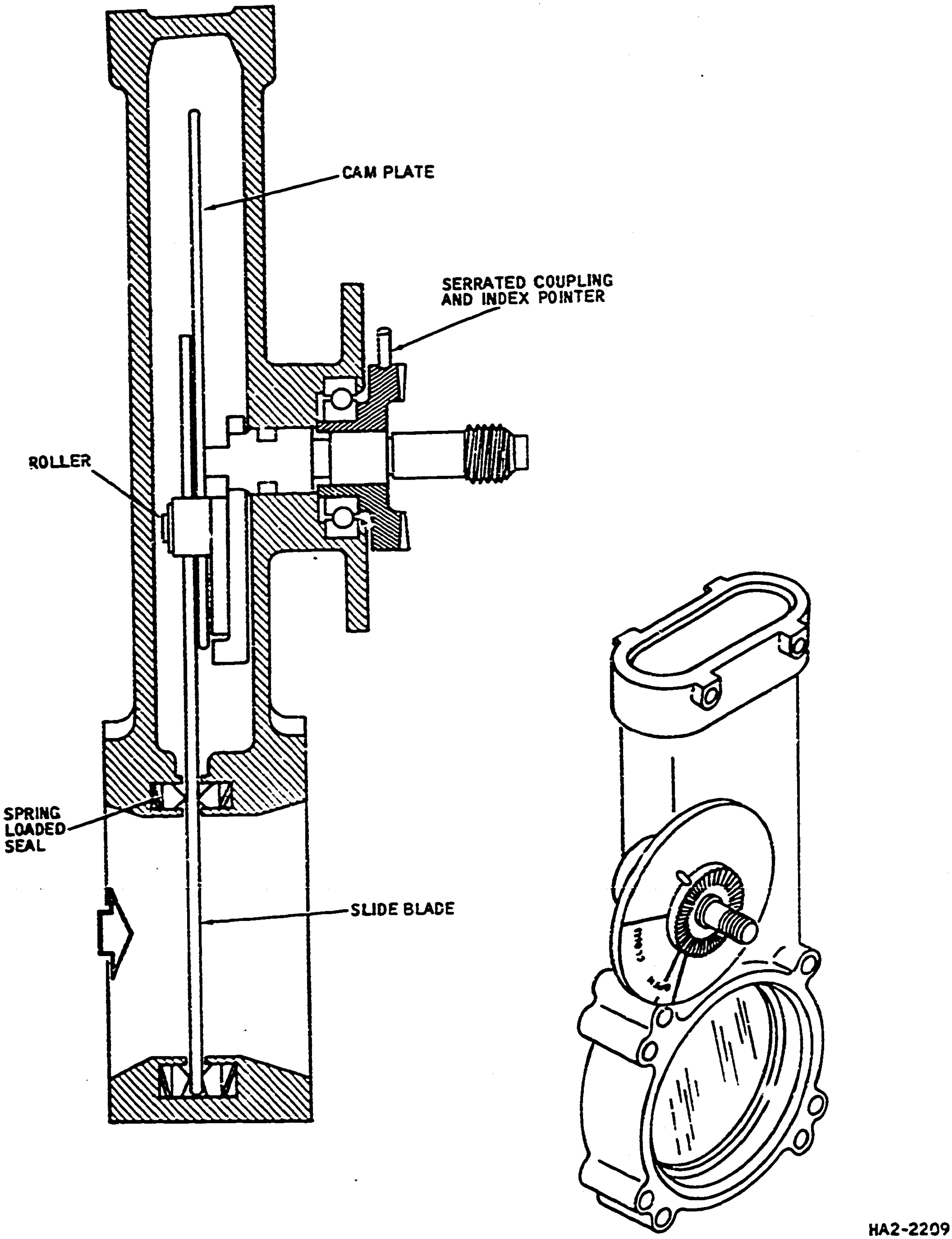
MINIATURE CHECK VALVE



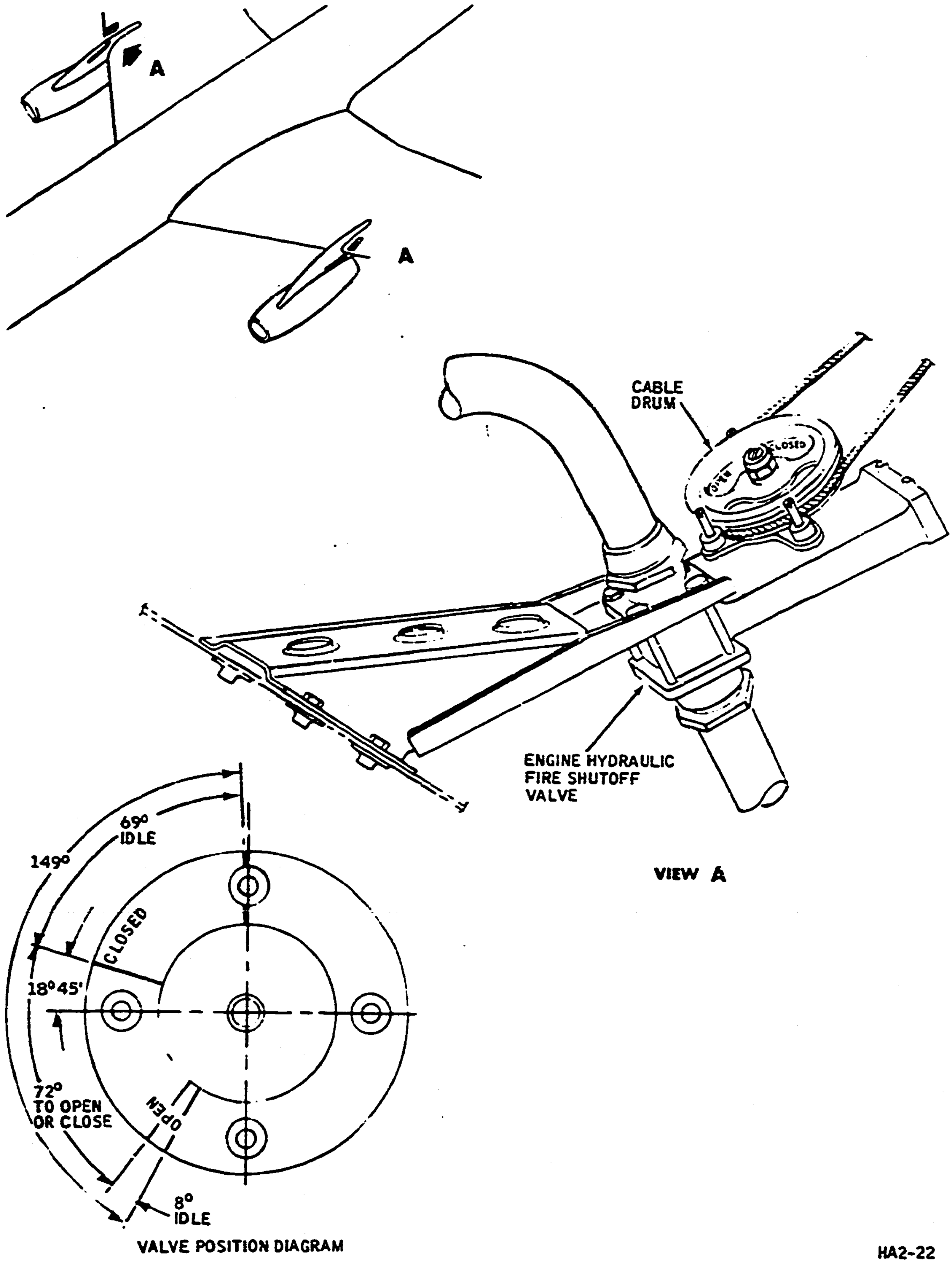
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drums, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figures 13 and 14.)

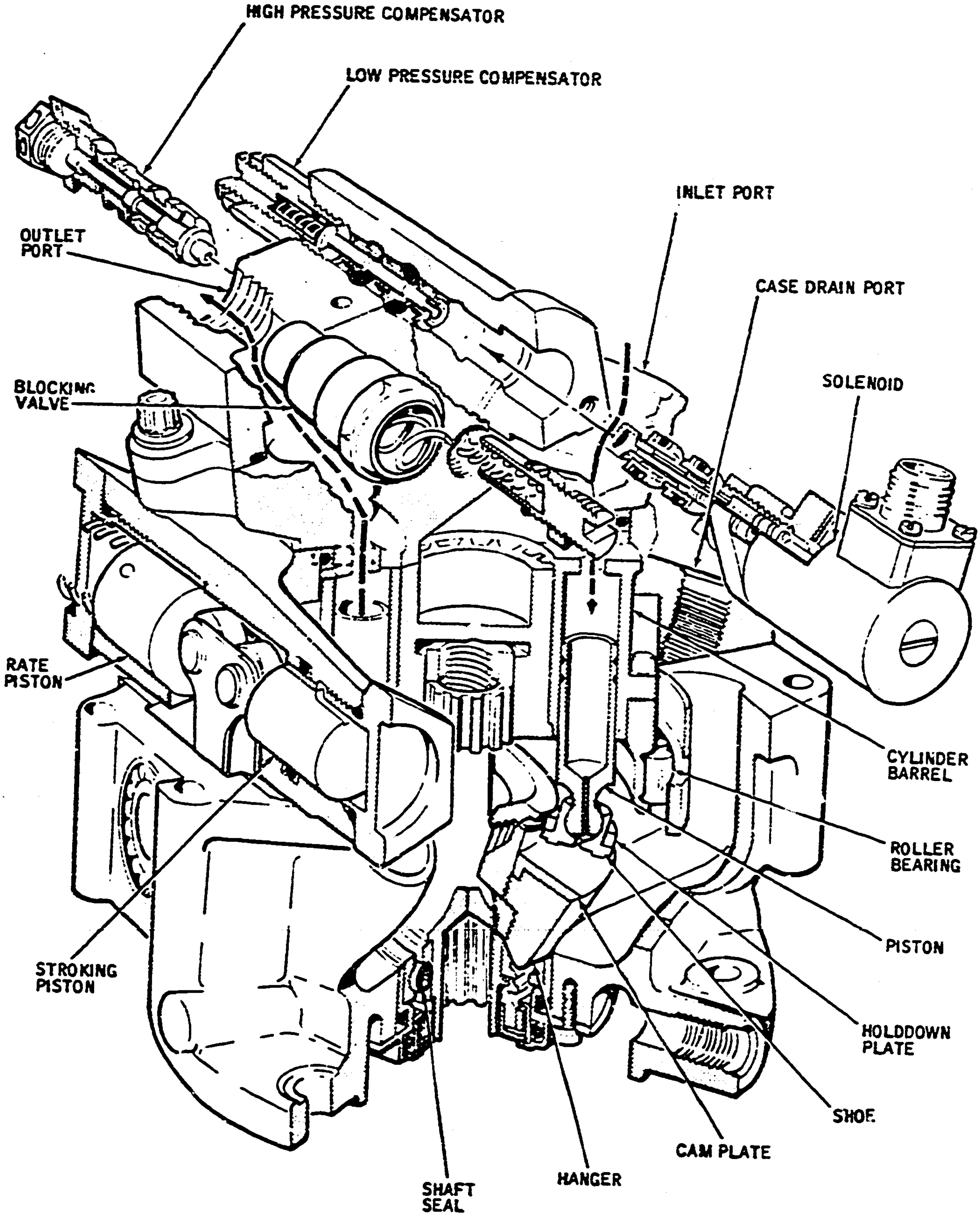
(1) The two, single-stage, variable-displacement, cam-actuated, pressure-compensated, engine-driven hydraulic pumps are installed, one each, on the inboard engines. The pump incorporates a solenoid-operated bypass feature for reducing the output pressure to zero psi. Each bypass valve solenoid is controlled by a corresponding engine hydraulic pump control switch in the flight compartment. The switch for the hydraulic pump on engine 2 is placarded left, on, and bypass. The switch for engine 3 is placarded right, on, and bypass. When a switch is placed in the bypass position, the bypass valve for that pump is actuated and the pump pressure is reduced to zero psi. When the switch is placed in the on position, the bypass valve is open and the pump operates normally in a pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system.

(2) The heart of the pump is a revolving cylinder barrel which contains nine pistons. By means of a hold-down plate and hydraulically balanced shoes, the pistons are supported on an inclined cam plate which causes them to reciprocate as the barrel revolves. The hold-down plate ensures positive stroking of the pistons during the suction stroke. The angle of the cam plate is varied by moving the trunnioned hanger on which it is mounted, thereby changing the displacement of the pump. The hanger, in turn, is controlled by a pressure compensator.

(3) Oil passes through the main inlet and then through porting in the end of the cylinder barrel to the cylinders from which the pistons are being withdrawn. As the cylinder barrel revolves, these pistons are forced into their bores and discharge high-pressure oil through porting in the end of the barrel to the outlet port.

(4) The cylinder barrel, supported by a radial bearing, is driven by an internal shaft which passes through the trunnioned hanger. A hydraulically balanced, face-type, carbon shaft seal is used to assure optimum sealing. Sealing pressure increases as case pressure increases, and the seal adjusts itself to compensate for any wear which takes place.

(5) The pressure compensator regulates the volume delivered in accordance with the demand of the system and maintains the predetermined pressure. When the pressure is less than the spring load, the spring moves the spool to vent oil in the stroking cylinder to the case. The stroking



Engine-Driven Hydraulic Pump -- Cutaway View
Figure 13

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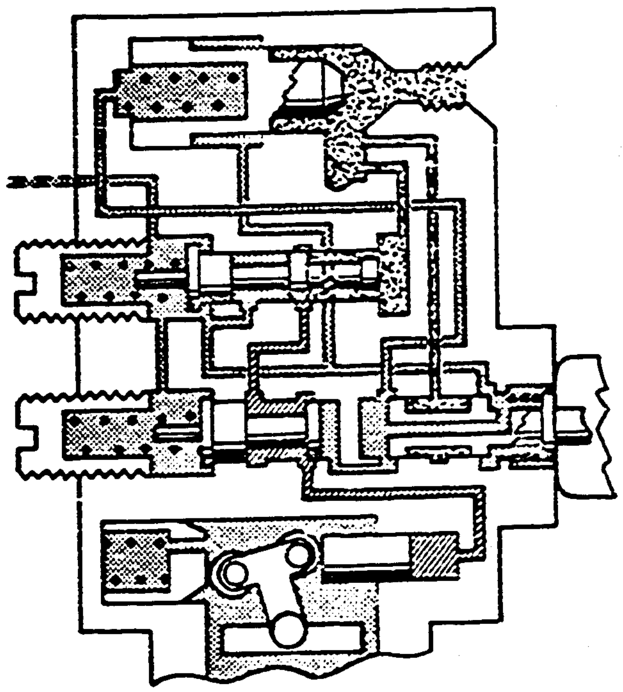
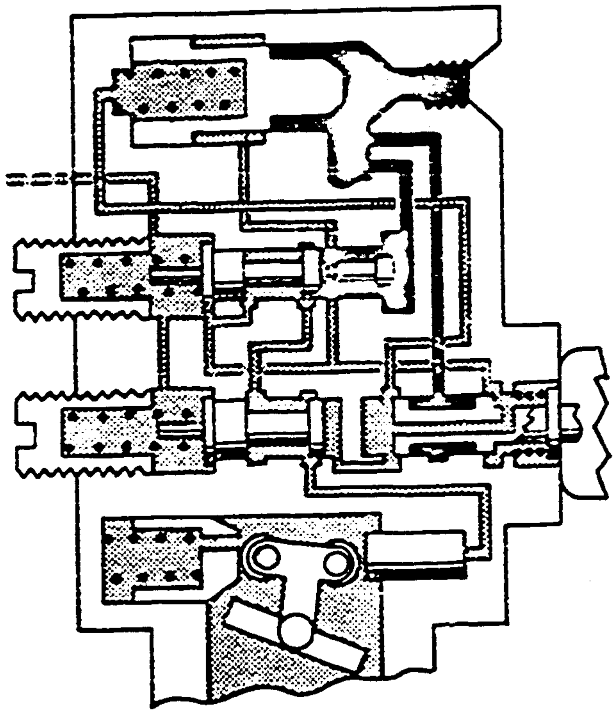


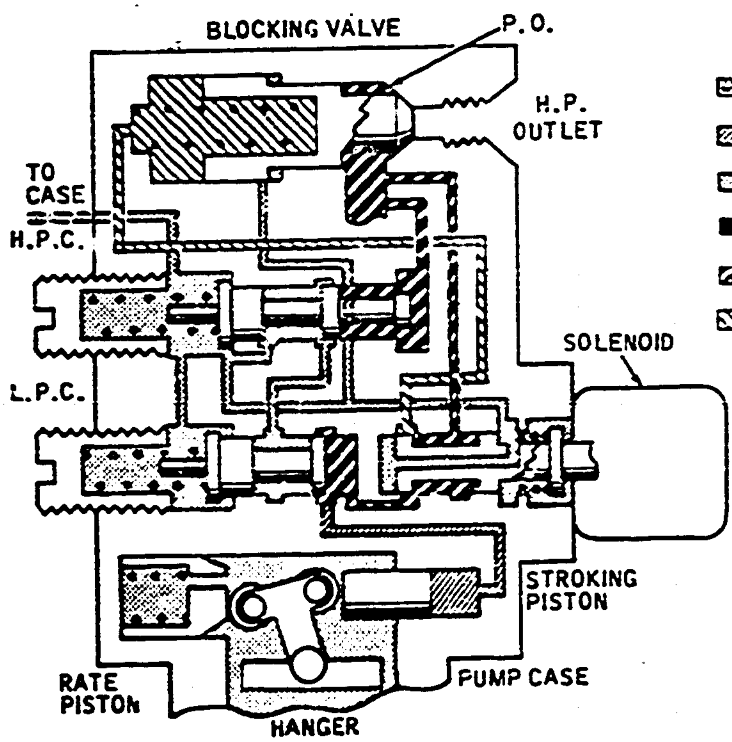
A. FULL PRESSURE, NO FLOW CONDITION

BLOCKING VALVE OPEN, 3,000 PSI FLUID AVAILABLE, NO DEMAND.



B. FULL FLOW CONDITION

BLOCKING VALVE OPEN, HANGER "ON STROKE" 3,000 PSI FLUID FLOWING FROM PUMP.



C. DEPRESSURIZED AND BLOCKED CONDITION

SOLENOID ENERGIZED, BLOCKING VALVE CLOSED, PUMP COMPENSATED AT 500 PSI.

KEY

- COMPENSATED PRESSURE: 3,000 ± 50
- CONTROL PRESSURE: 200-300
- CASE PRESSURE: 45-55
- FULL FLOW PRESSURE: TO 2,950
- DEPRESSURIZED PRESSURE: 400-500
- BLOCKING VALVE PRESSURE: 400-500
- P.O. = PUMP OUTLET
- H.P.C. = HIGH PRESSURE COMPENSATOR
- L.P.C. = LOW PRESSURE COMPENSATOR

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Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 14

piston then retracts and a spring load on the hanger moves it to a greater angle and increases the volume pumped. The axial thrust of the pistons against the cam plate during power stroke is balanced hydraulically. Oil, at system pressure, is admitted through holes in the piston and shoe to an undercut area in the face of the piston shoe. The pressure applied to the undercut area, which is slightly less than the piston area, effectively balances the forces so that the shoe is supported on an oil film at all times. Balance is controlled to such a degree that there is no excessive leakage, and high volumetric efficiency is maintained.

(6) The axial thrust of the cylinder barrel is also balanced hydraulically against the port plate.

(7) Because of these features, the axial thrust of the pistons is transferred hydraulically, eliminating the need for antifriction thrust bearings. This increases the reliability factor, if contamination or other adverse conditions exist.

(8) The pump functions as a standard, pressure-compensated pump, when the bypass solenoid is not energized. Energizing the solenoid allows the pump to compensate at a reduced, controlled pressure of approximately 500 psi. Also incorporated in the cap is a blocking valve. The valve shuts off the discharge flow from the pump, when the 500 psi compensating valve takes over as a result of the solenoid being energized. Hence, depressurizing the pump permits operation with the pump completely feathered at approximately 1/2 drive torque required at 3000 psi. The blocking valve is automatically controlled by the depressurizing valve. When the solenoid is energized, the blocking valve prevents flow from the pump discharge port. When the solenoid is deenergized, the blocking valve automatically opens as the pump builds up pressure to match the system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 15.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 16.)

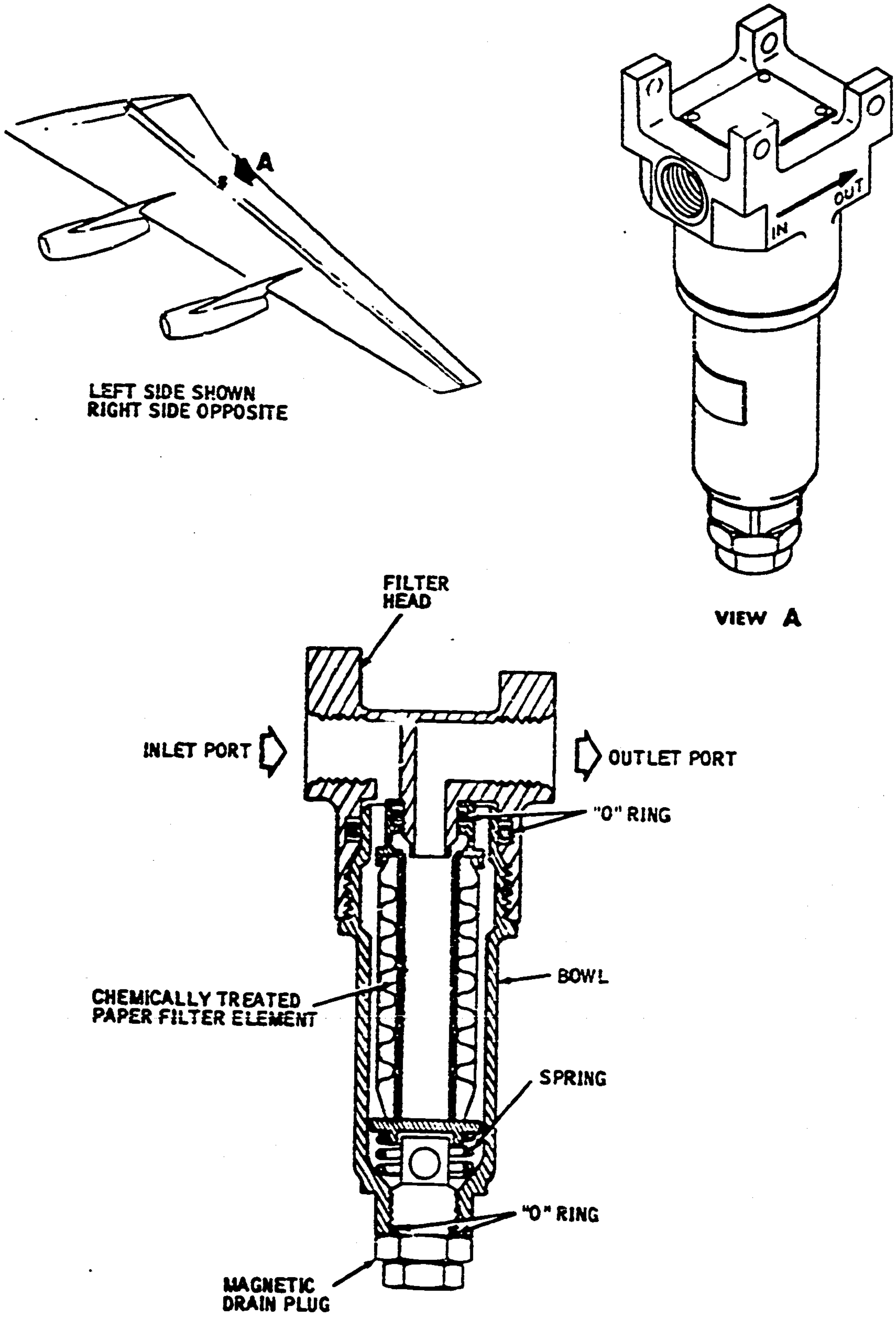
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

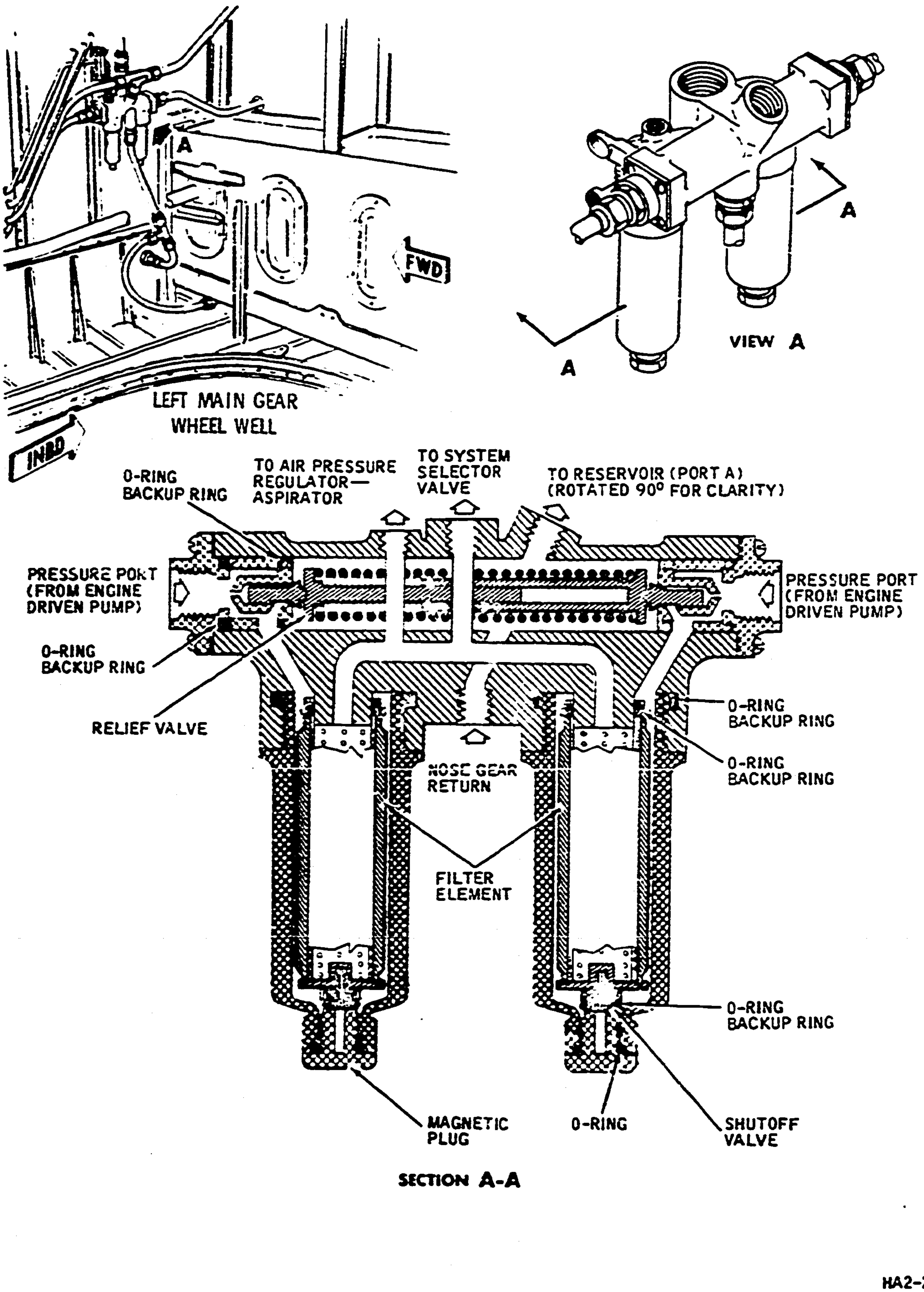
(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



HA2-31

Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 15



Dual-Filter and Relief Valve -- Cutaway View
Figure 16

O. System Selector Valve (See Figures 17 and 18.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

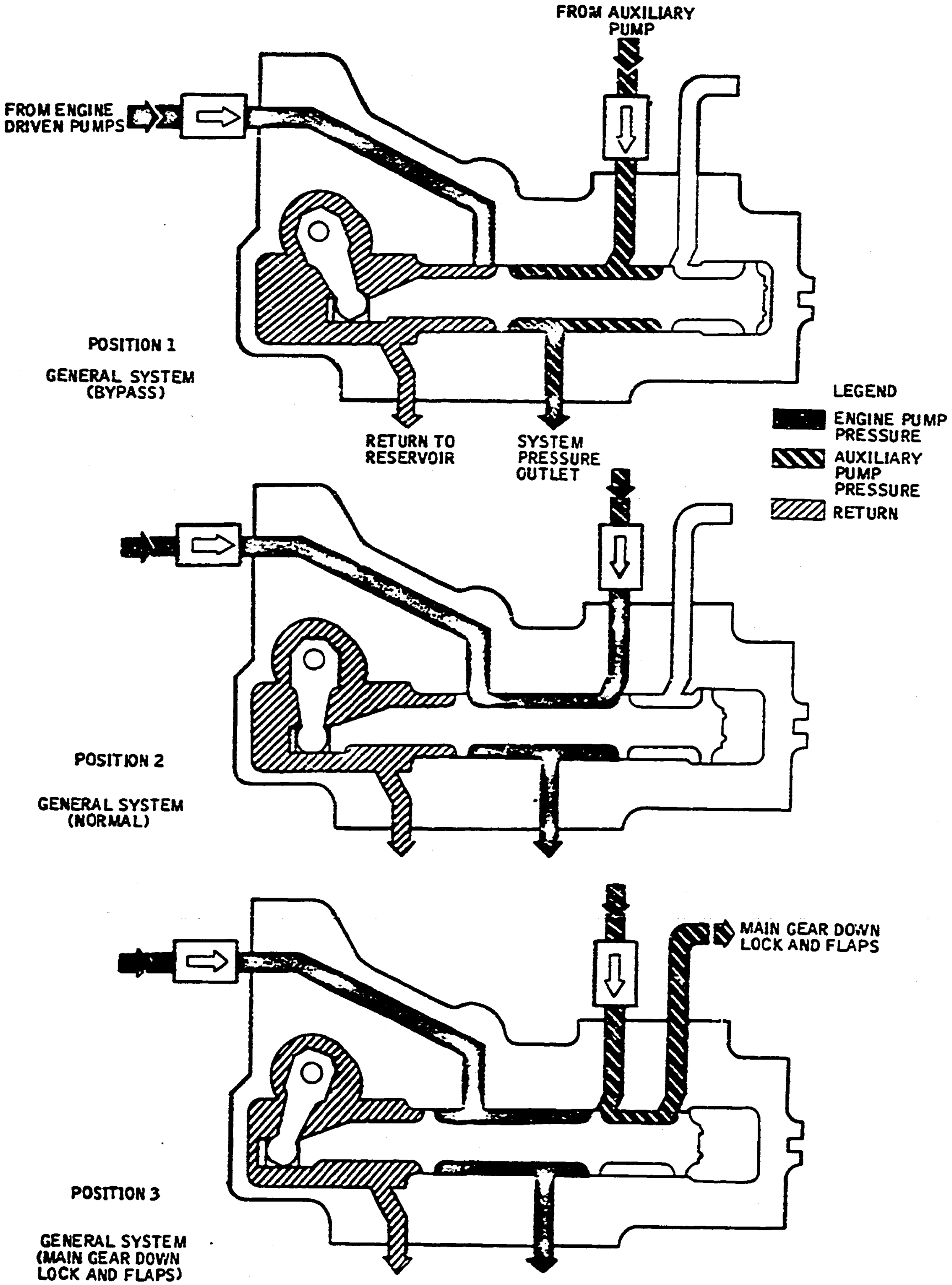
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

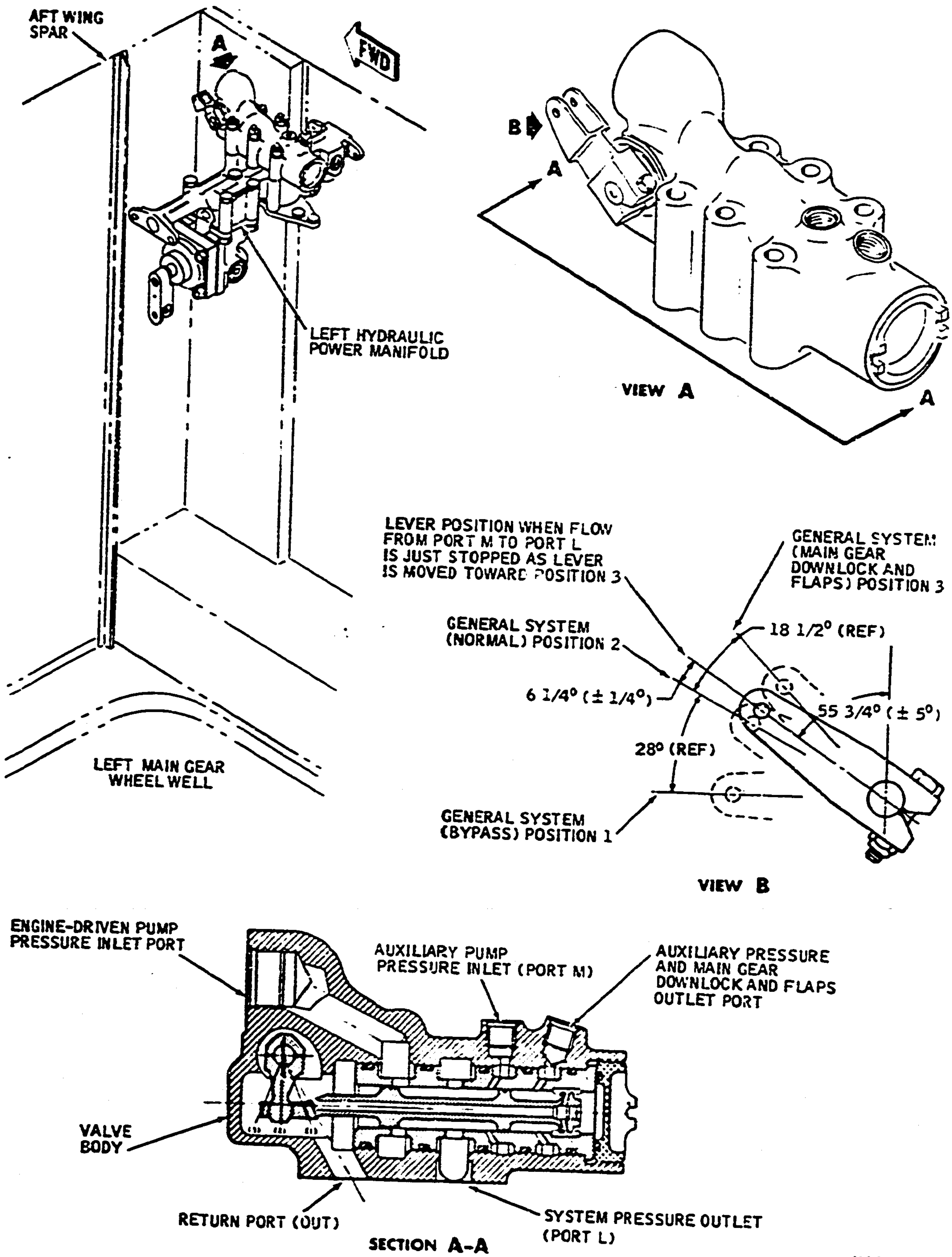
P. Left Hydraulic Power Manifold (See Figure 19.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

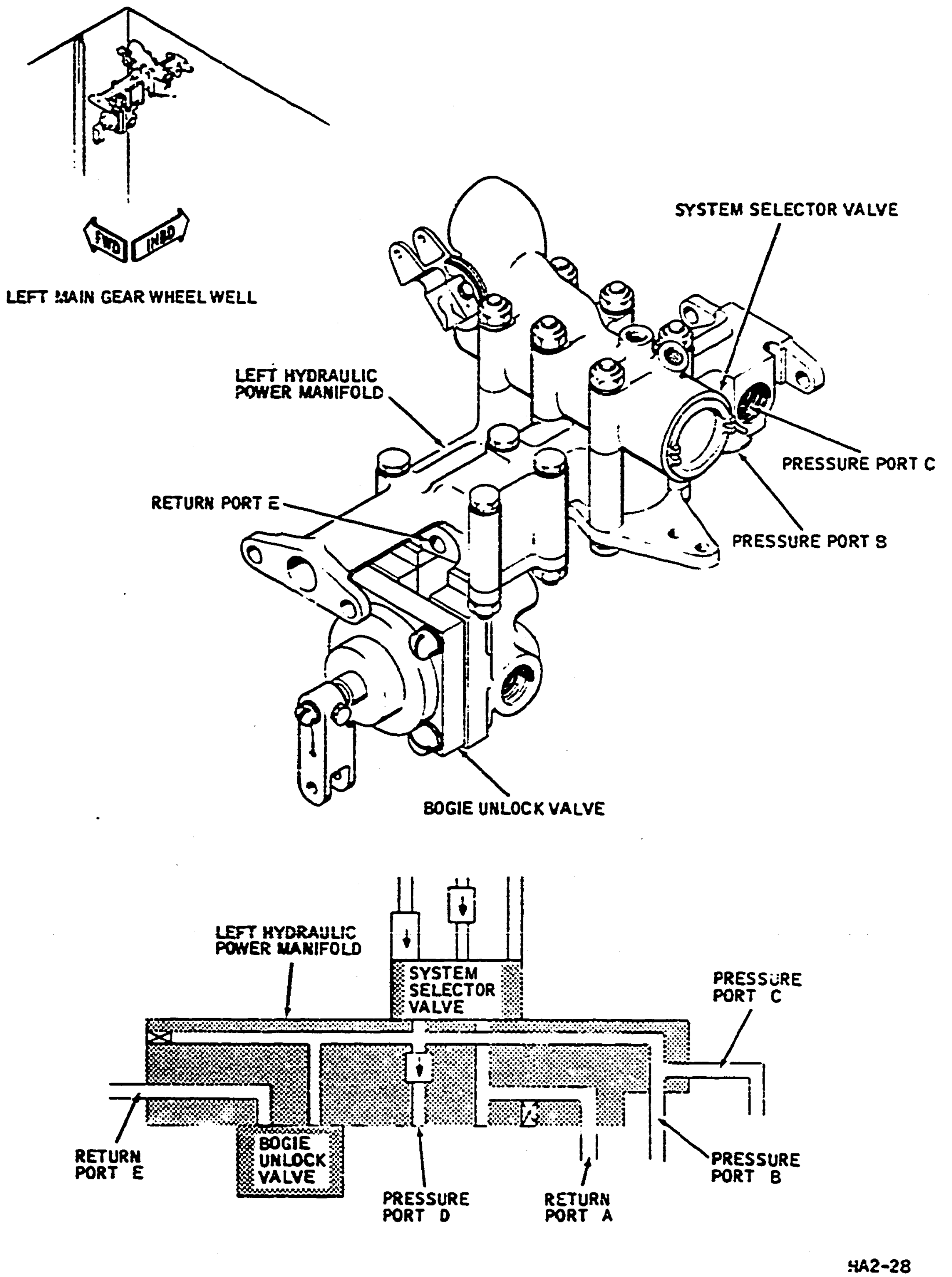
(2) Three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold pressure



System Selector Valve -- Schematic
Figure 17



System Selector Valve -- Cutaway View
Figure 18



Left Hydraulic Power Manifold -- Schematic
Figure 19

outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

Q. Right Hydraulic Power Manifold (See Figure 20.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in placd with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

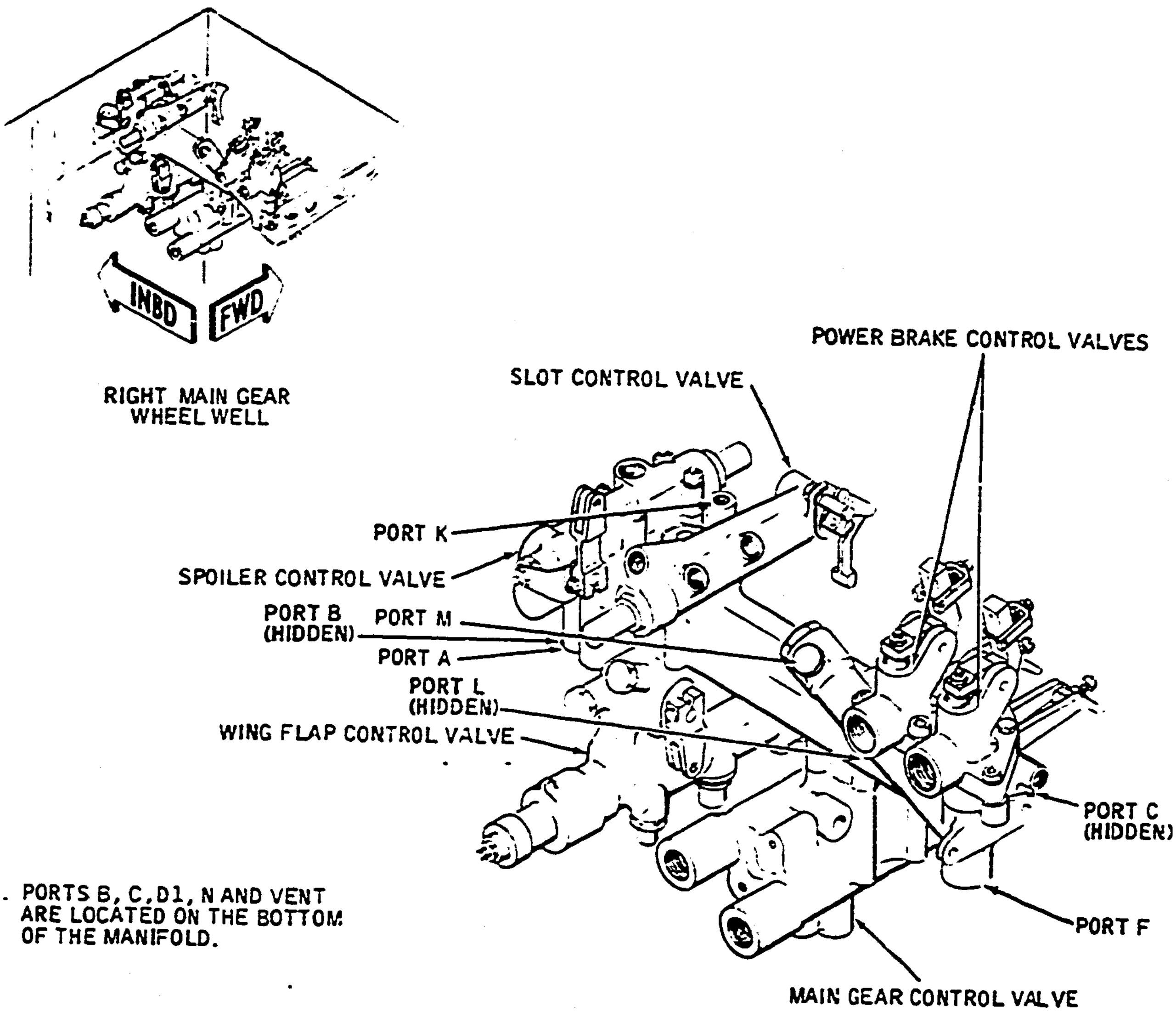
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

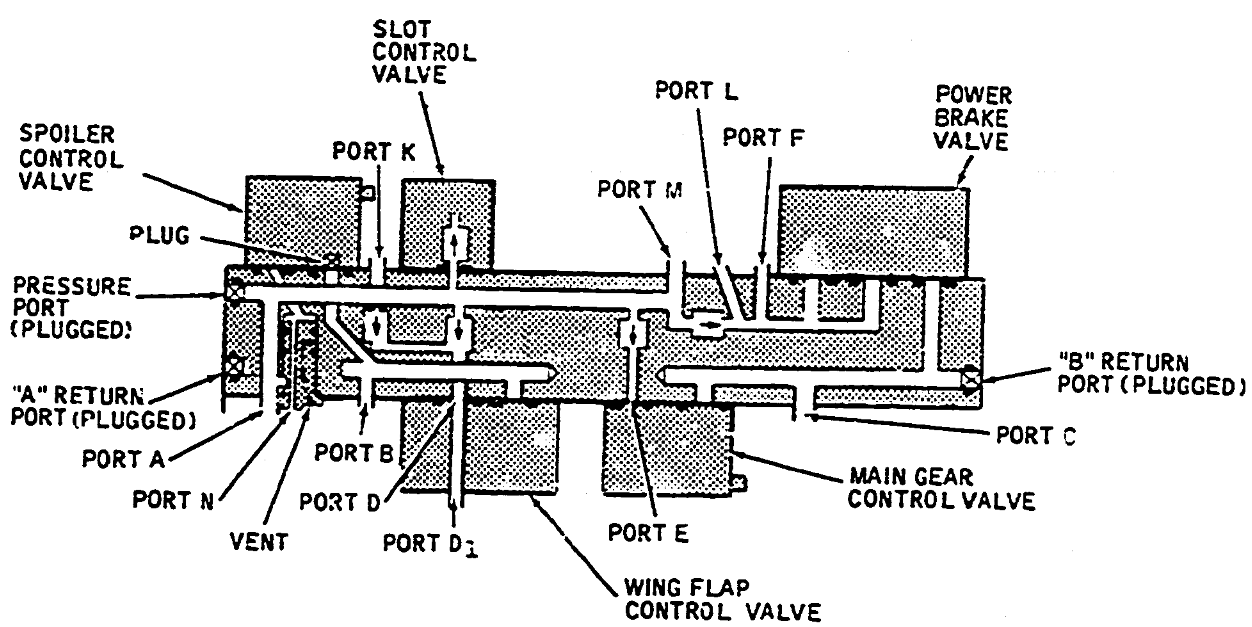
R. Hydraulic Manifold Return Check Valves (See Figure 10.)

(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.



NOTE. PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



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Right Hydraulic Power Manifold -- Schematic
Figure 20

S. Hydraulic Power System Accumulator (See Figure 21.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

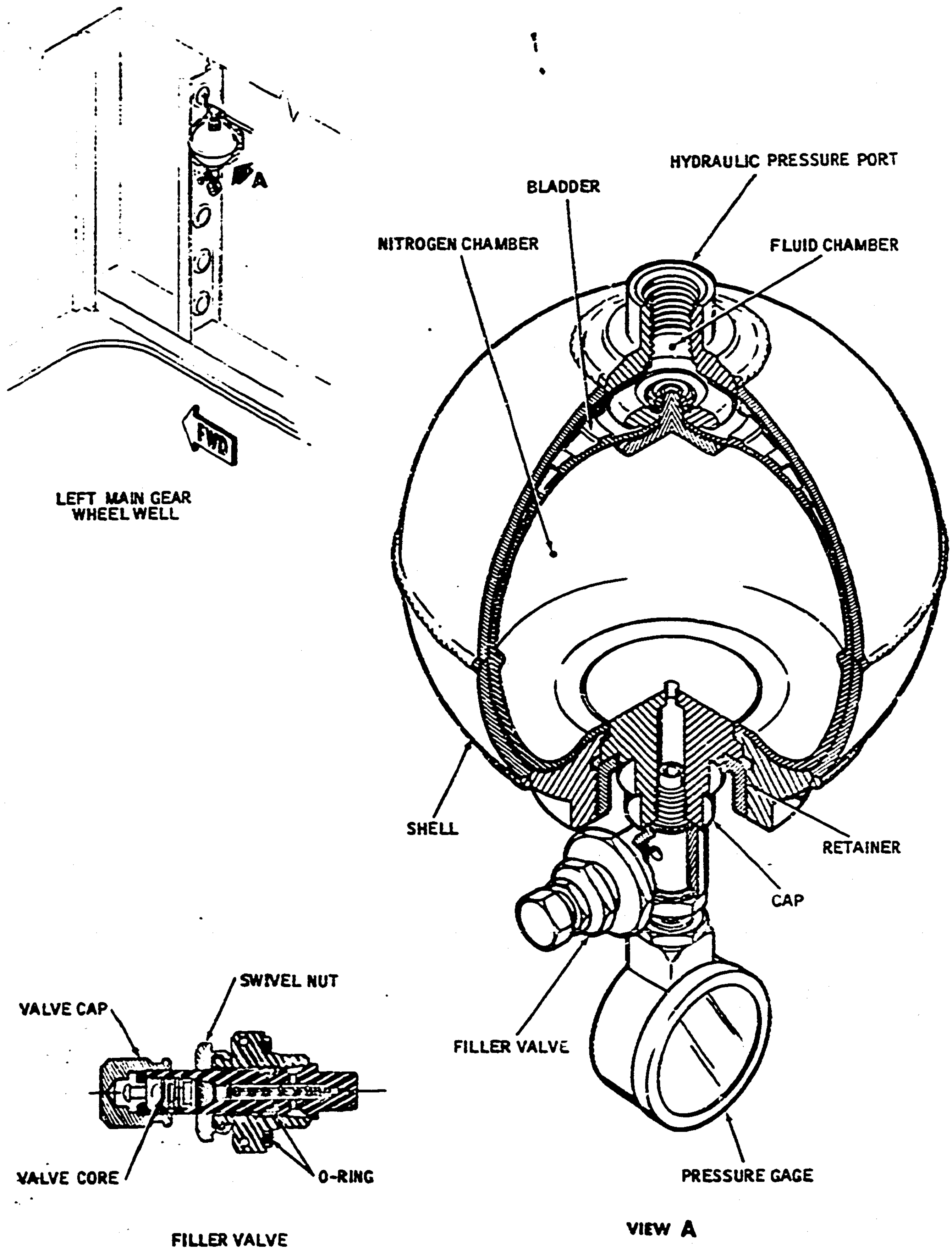
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

T. Hydraulic System Priority Valve (See Figure 22.)

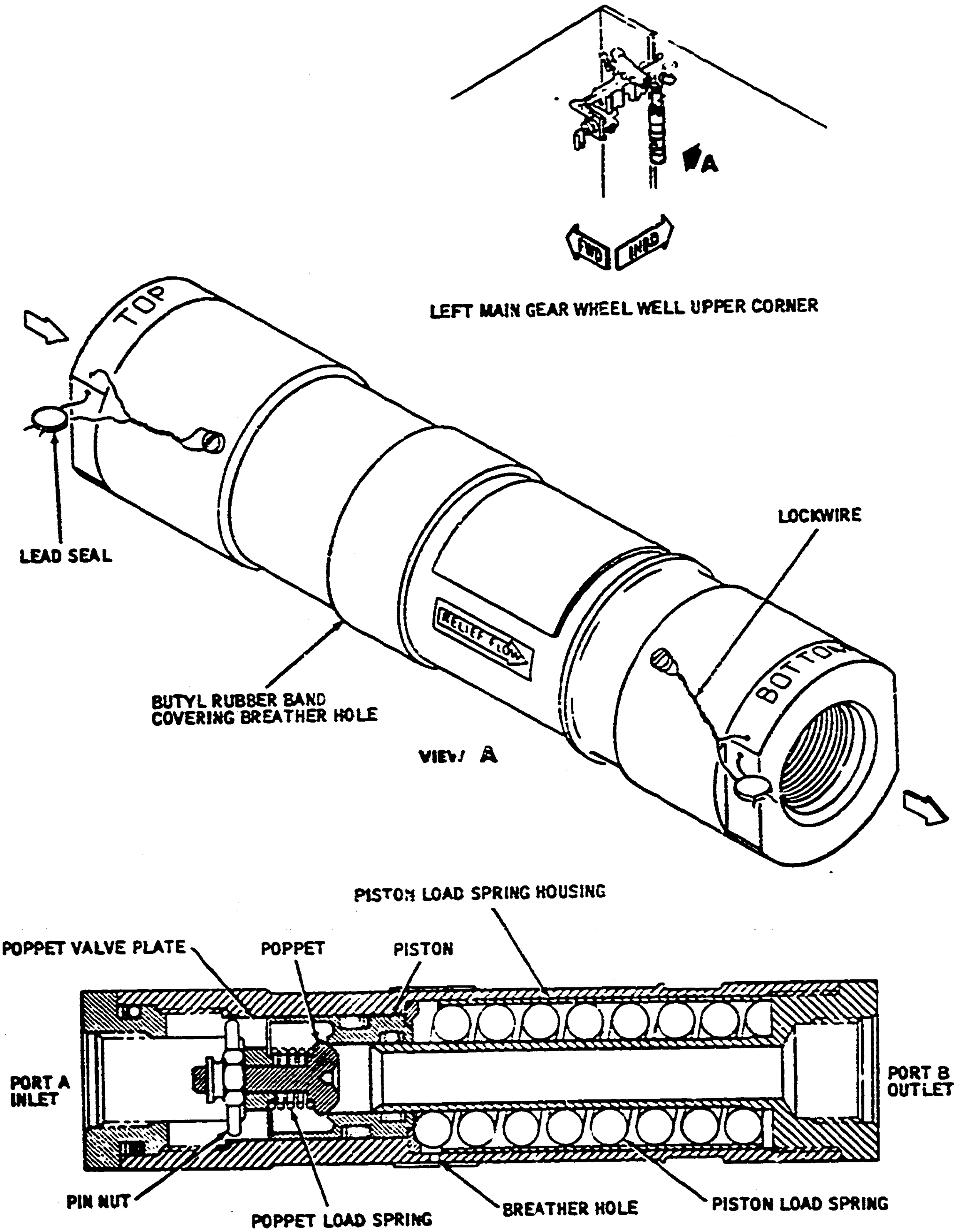
(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure



Hydraulic Power System Accumulator -- Cutaway View
Figure 21



Hydraulic System Priority Valve -- Cutaway View
Figure 22

is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the

auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. GENERAL

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

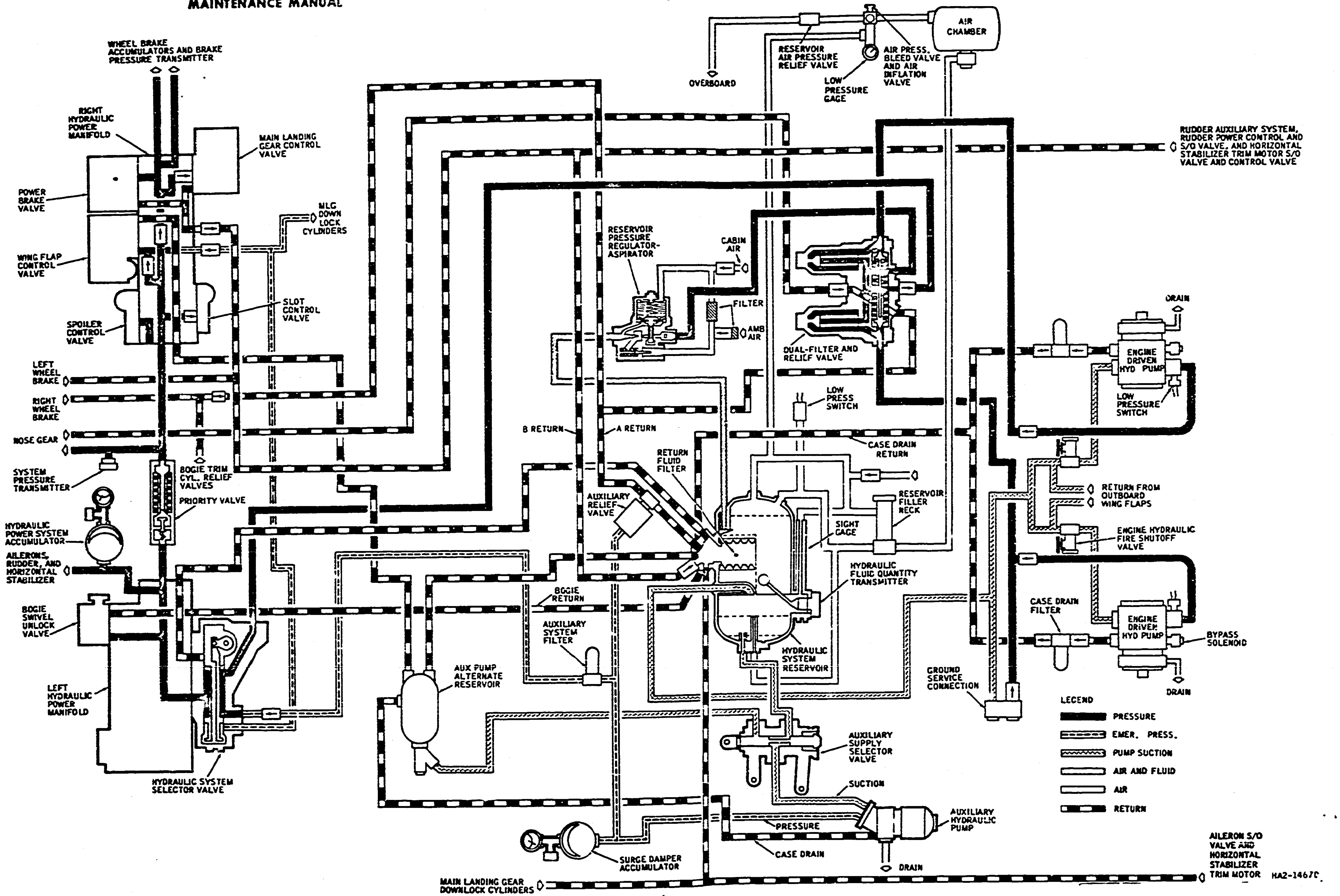
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.



Hydraulic Power System -- Schematic Diagram
(Airplanes N8774 - N8778)
Figure 1 (Sheet 1)

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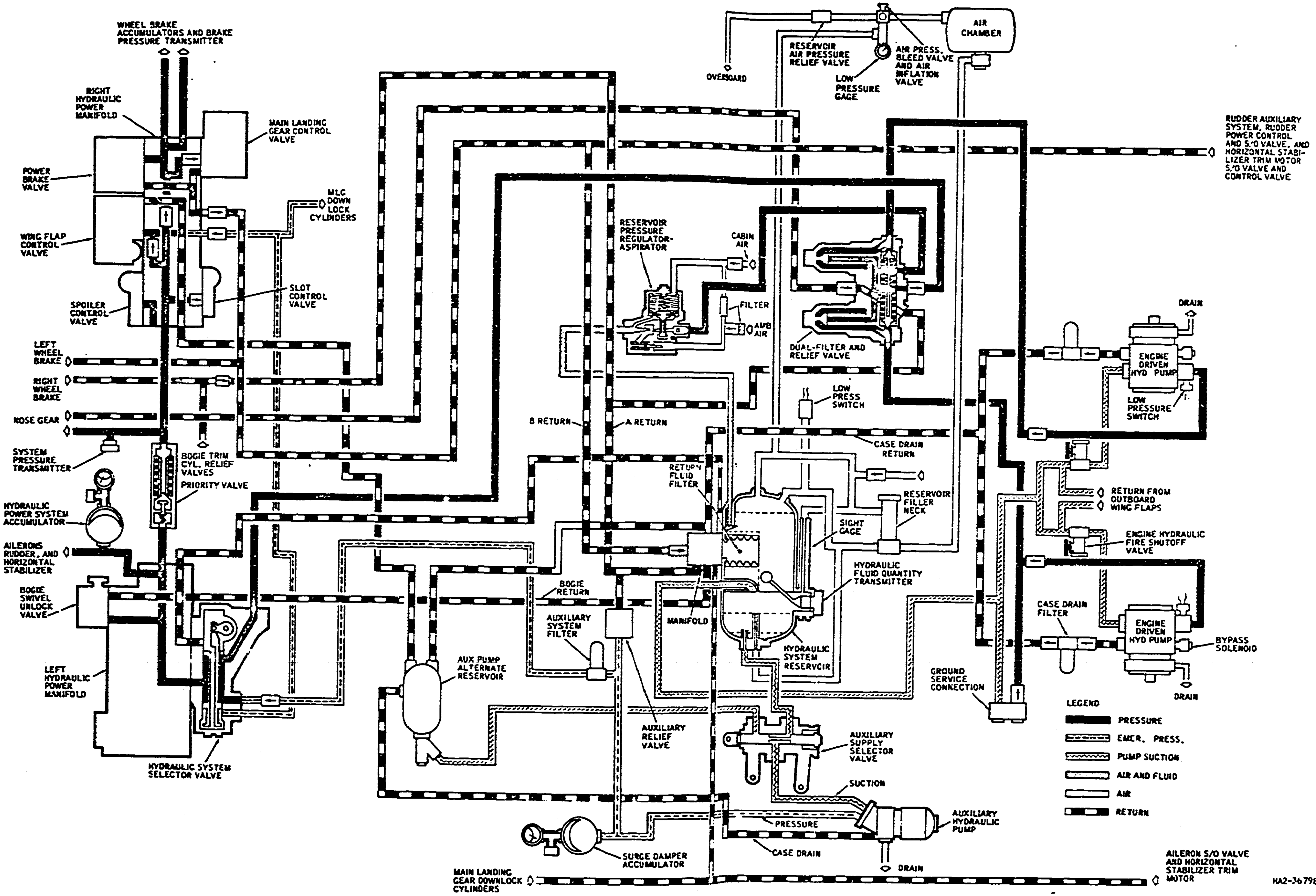

Hydraulic Power System -- Schematic Diagram
(Airplanes N8762-N8773)
Figure 1 (Sheet 2)

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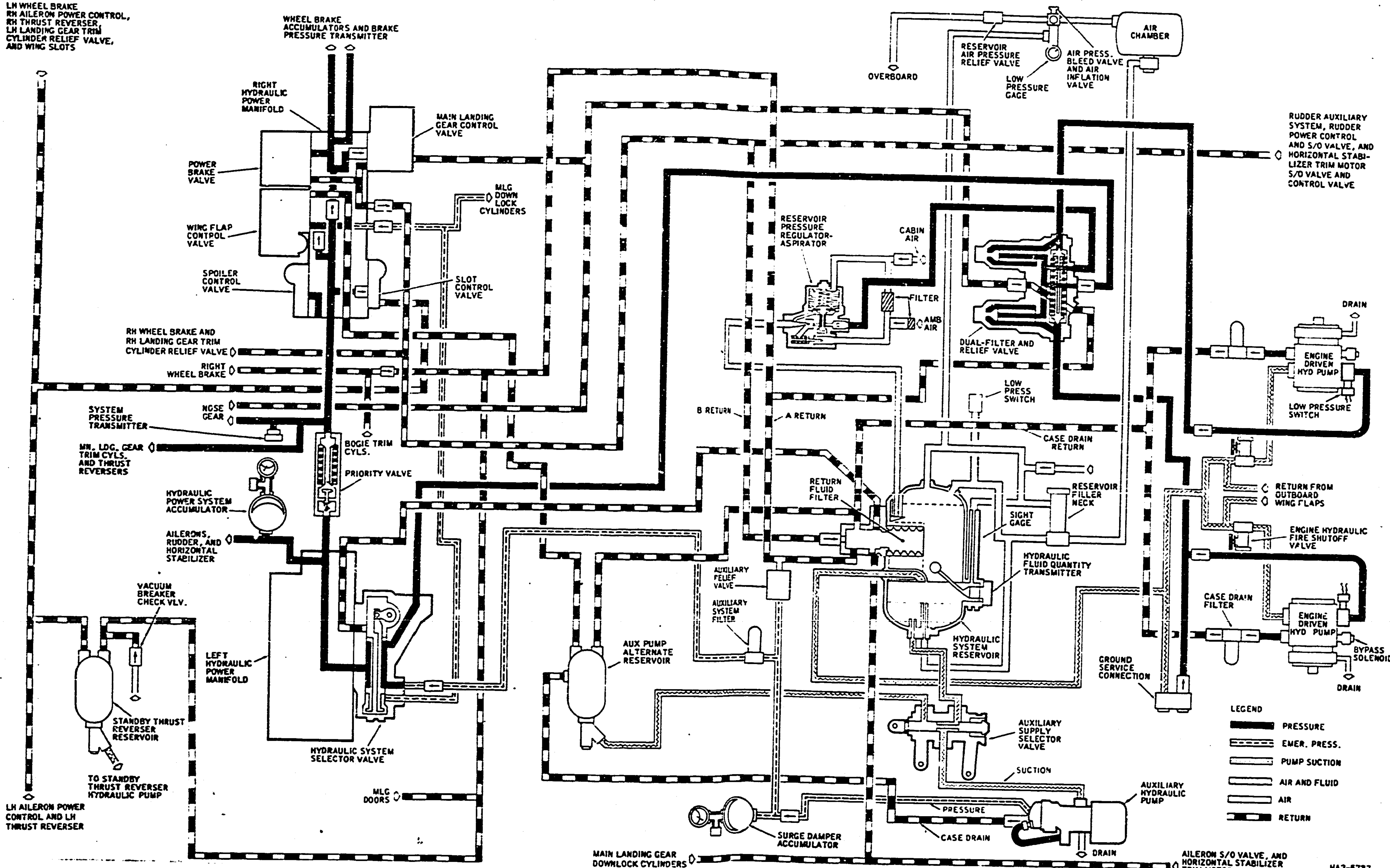

Hydraulic Power System -- Schematic Diagram
(Airplanes N8755-N8760)
Figure 1 (Sheet 3)

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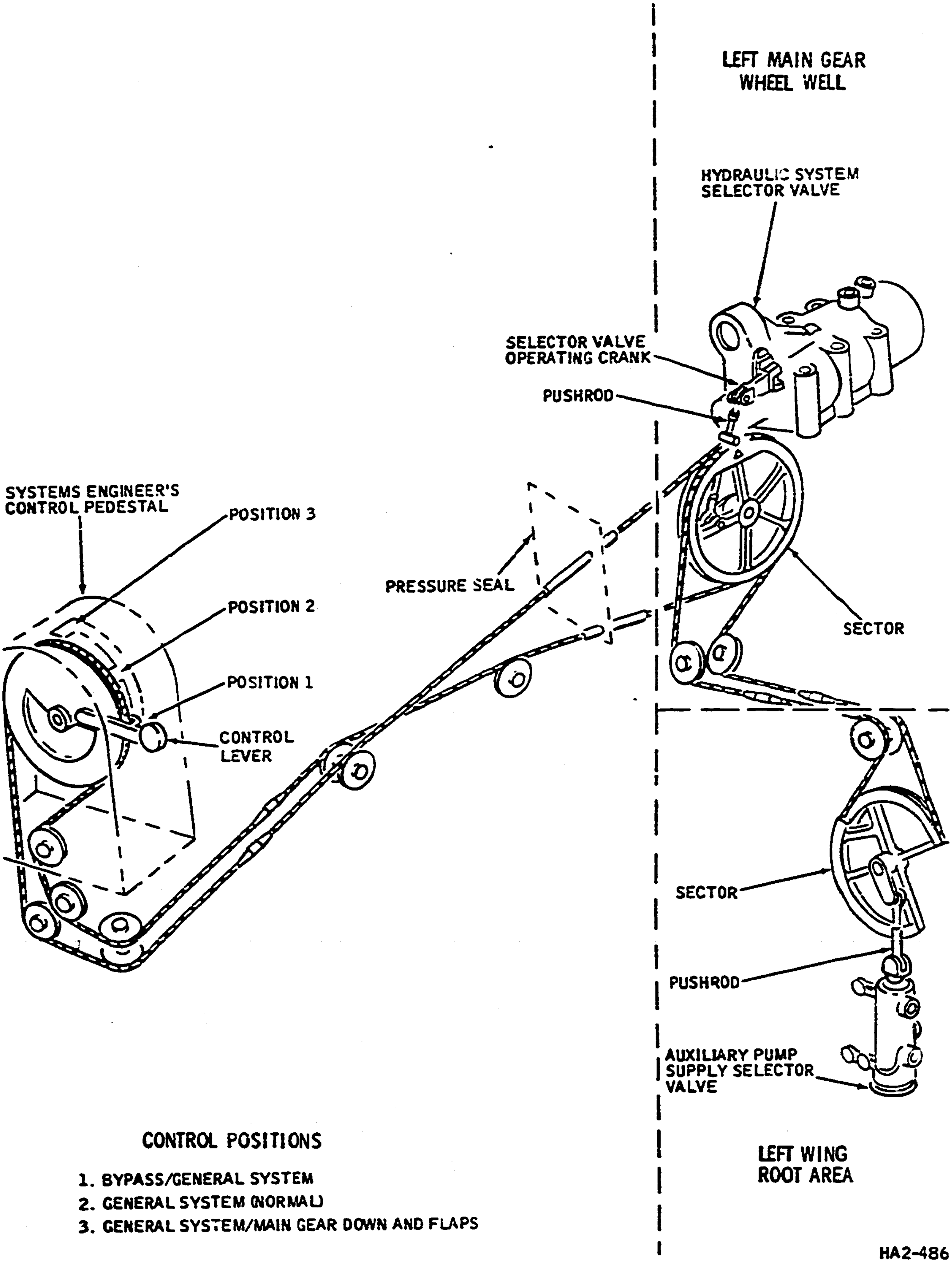


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

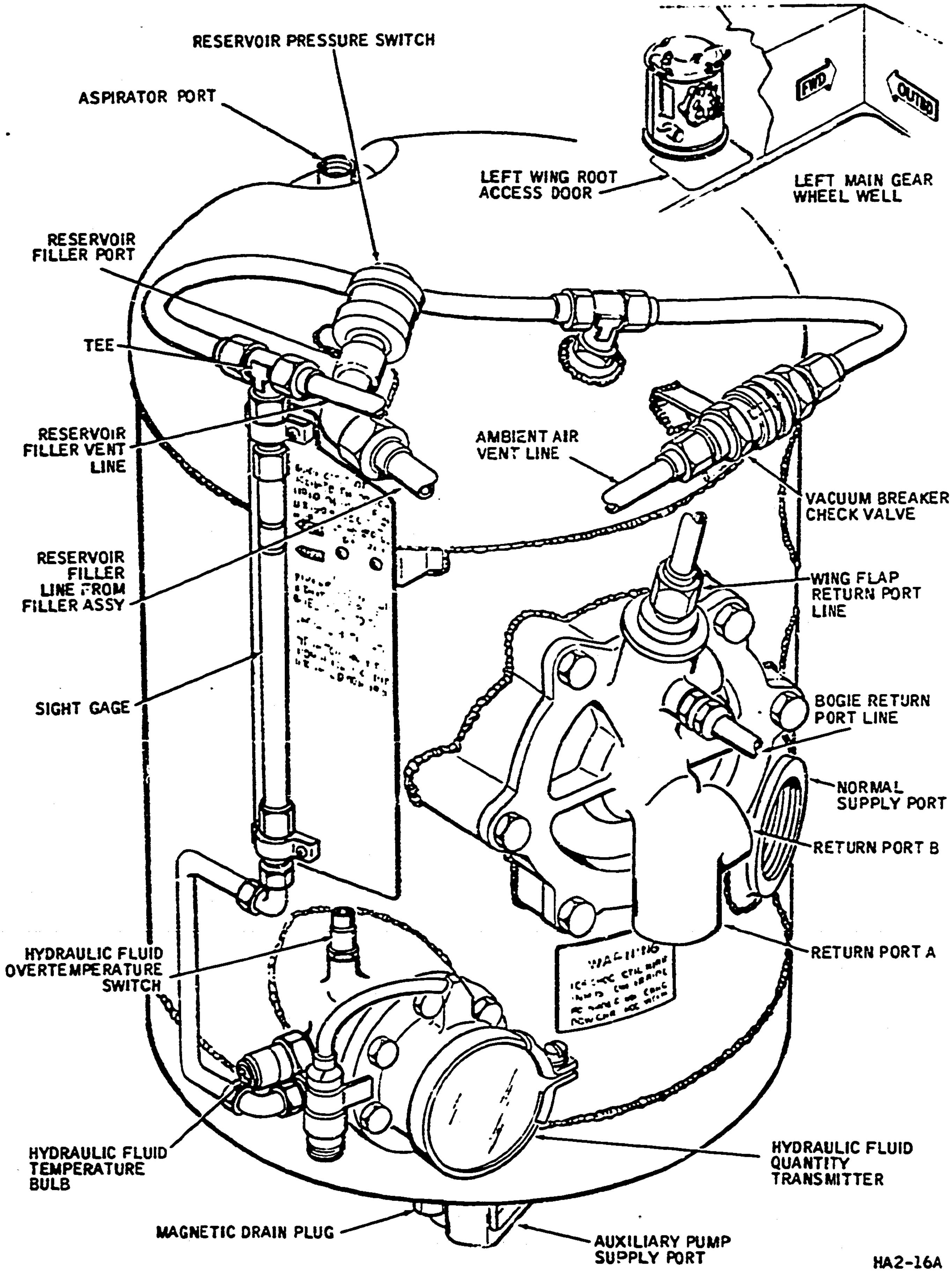
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior



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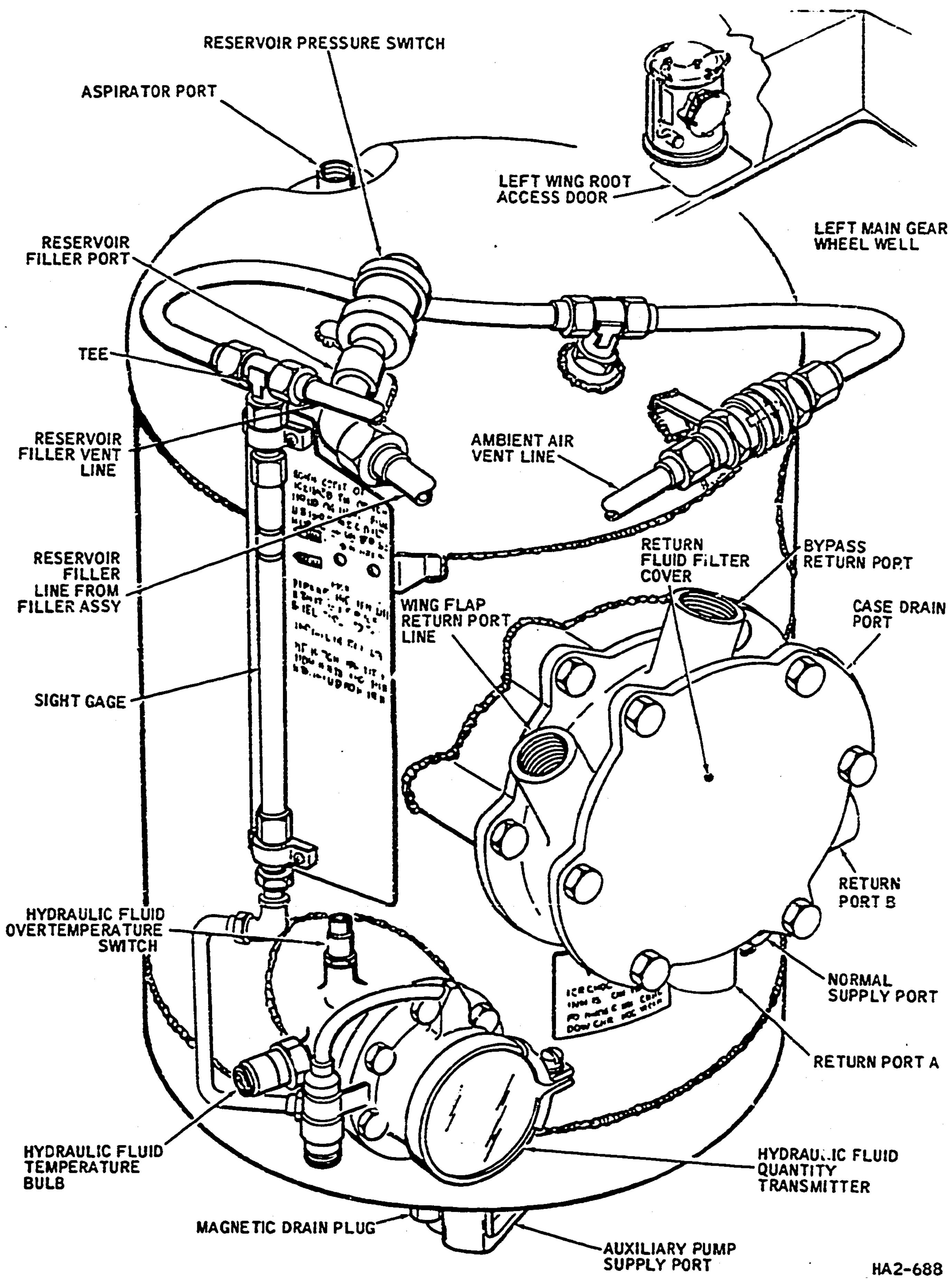
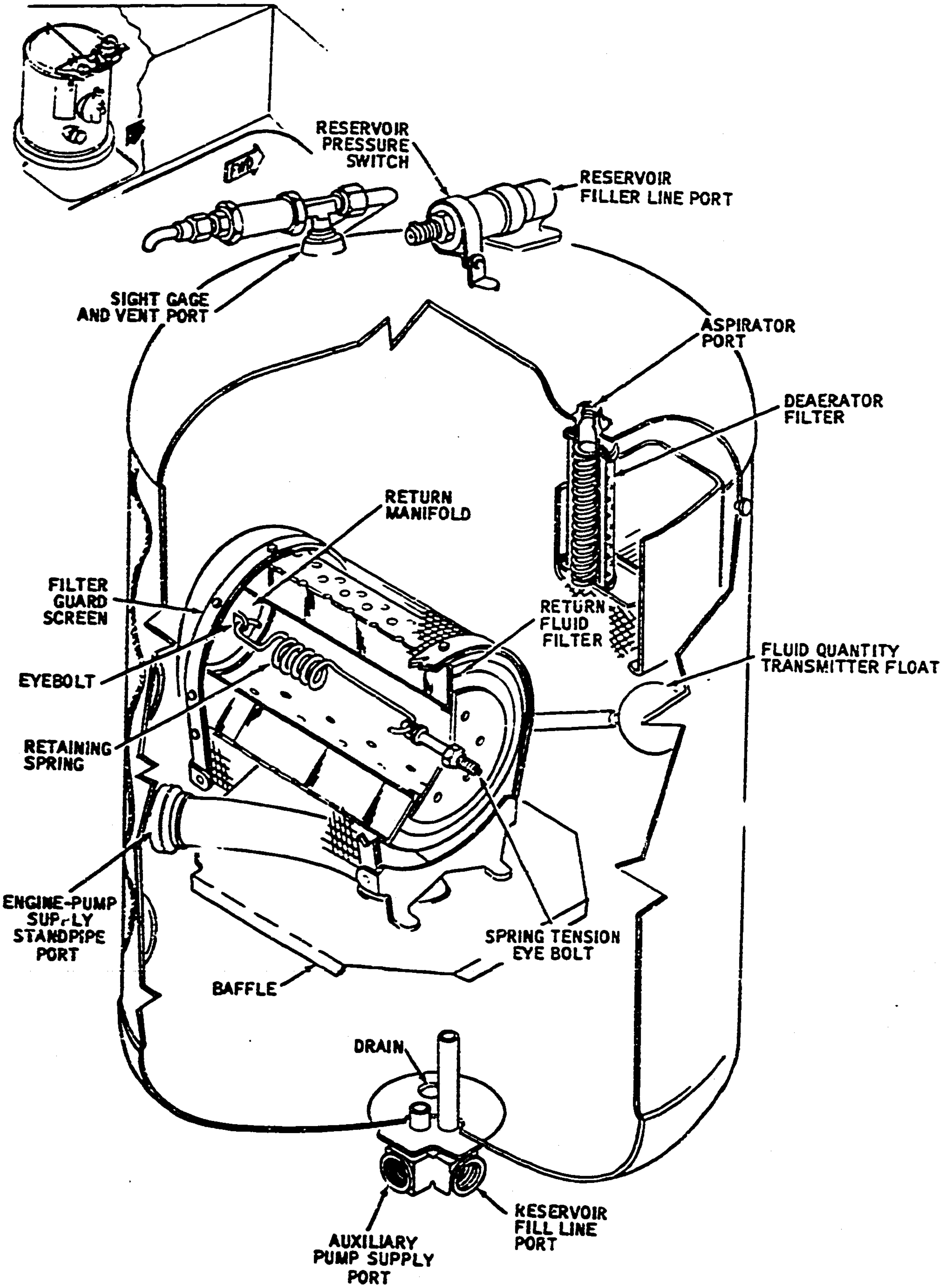
Hydraulic System Reservoir -- External View
(Airplanes N8774 - N8778)
Figure 3 (Sheet 1)



Hydraulic System Reservoir -- External View
(Airplanes N8755-N8760, N8762-N8773)
Figure 3 (Sheet 2)



Hydraulic System Reservoir -- Cutaway View
Figure 4

surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) On airplanes N8774-N8778, the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The manifold is bolted to the flange and contains five ports: return port A, located at the bottom; return port B, located at the lower right side; the low-pressure return port, located at the upper right; the wing flap return port, located at the top; and the bogie return port, located on the face of the manifold just below the wing flap return port.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the manifold holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) On airplanes N8755-N8760 and N8662-N8773, the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(7) The return fluid filter is installed in the reservoir behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(8) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold and is spring loaded to act as its own relief valve. On airplanes N8774-N8778, access to the filter is by removing the return ports manifold. Removal of the return ports manifold necessitates disconnecting the return lines from the manifold and removal of six bolts which secure the manifold to the reservoir. The filter which is attached to the manifold is then withdrawn from the reservoir. On airplanes N8755-N8760 and N8762-N8773, access to the filter is gained by removing the return filter cover from the return ports manifold by removal of six bolts. The filter is attached to the cover by a retaining spring, and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

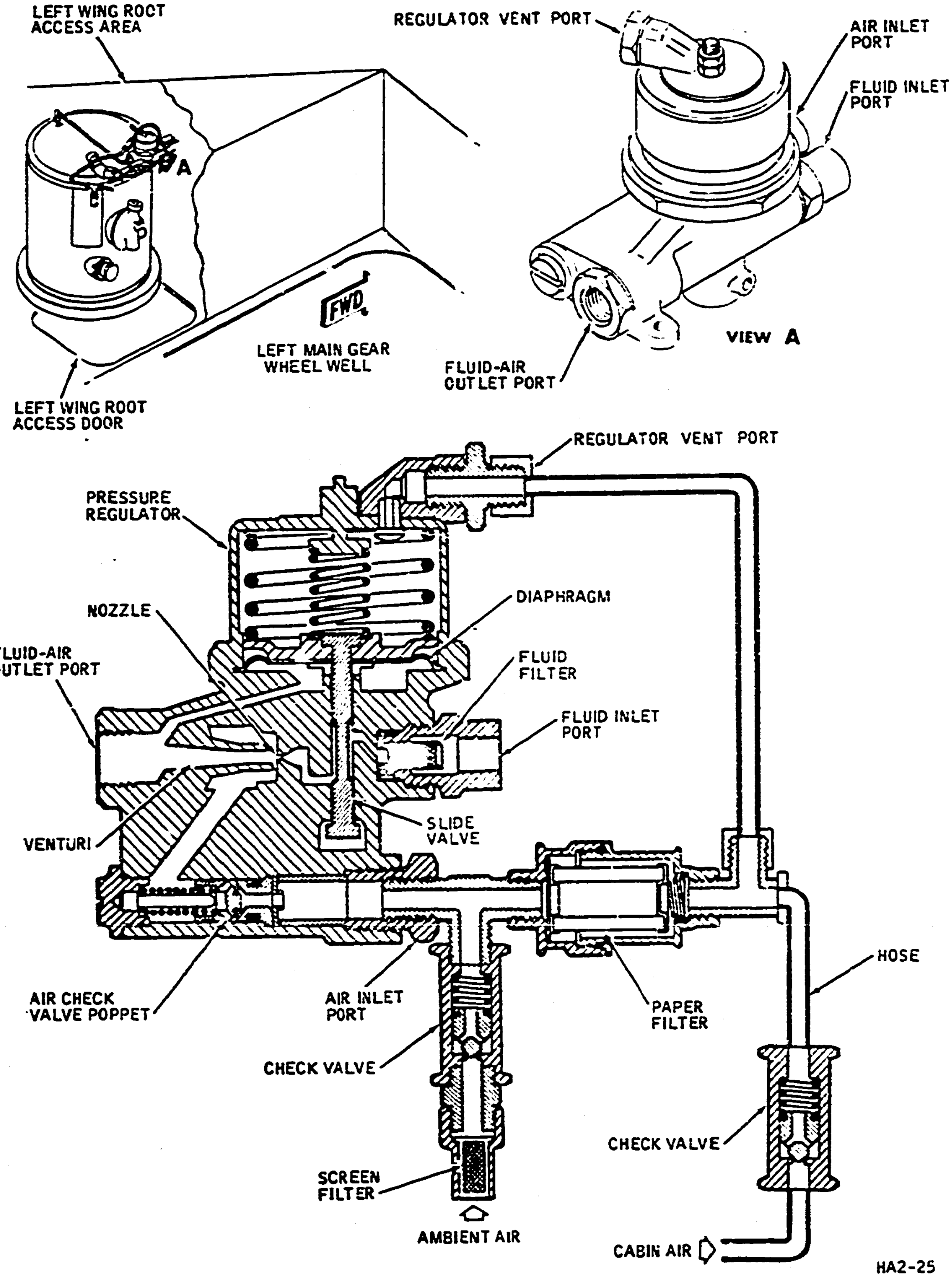
(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

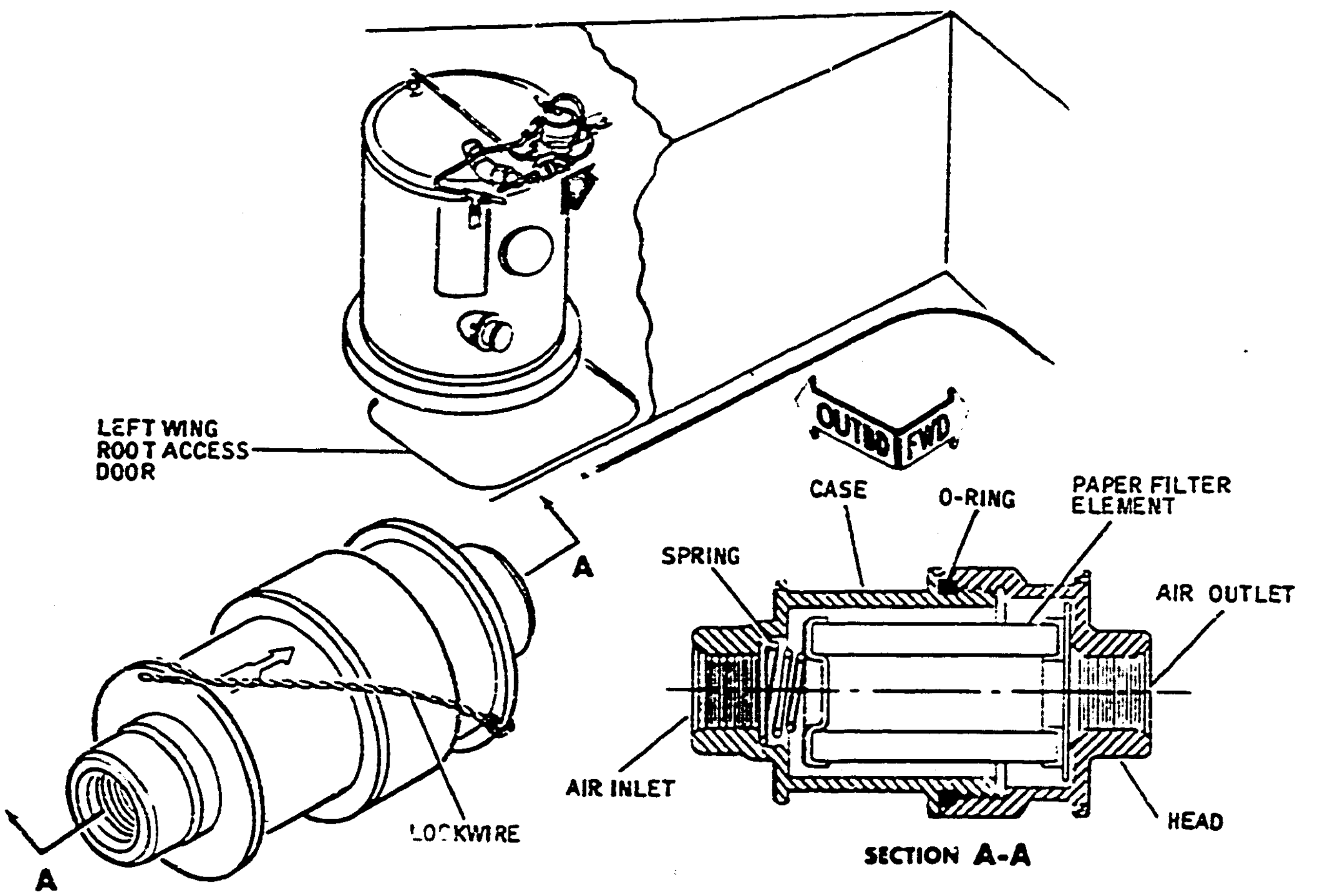
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

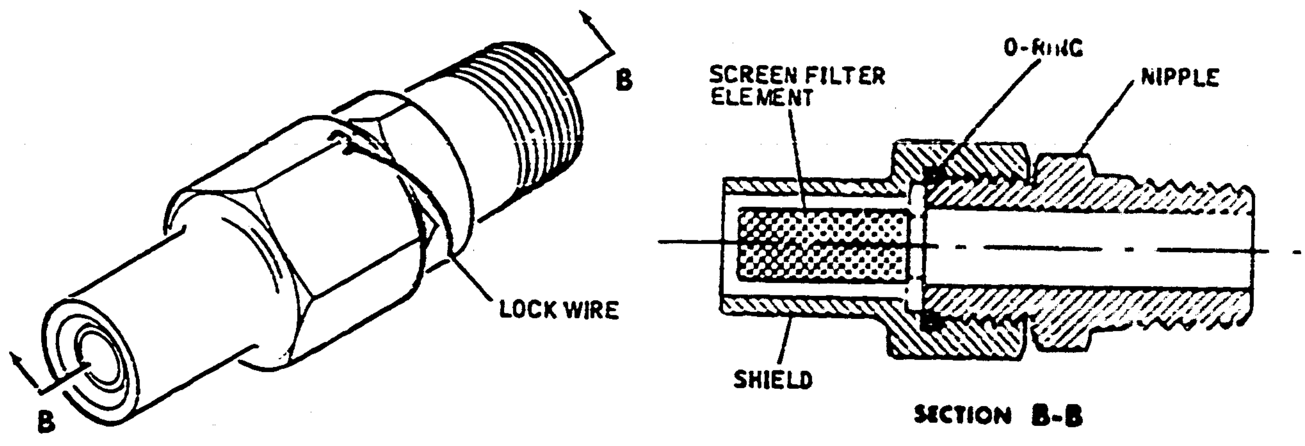
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.



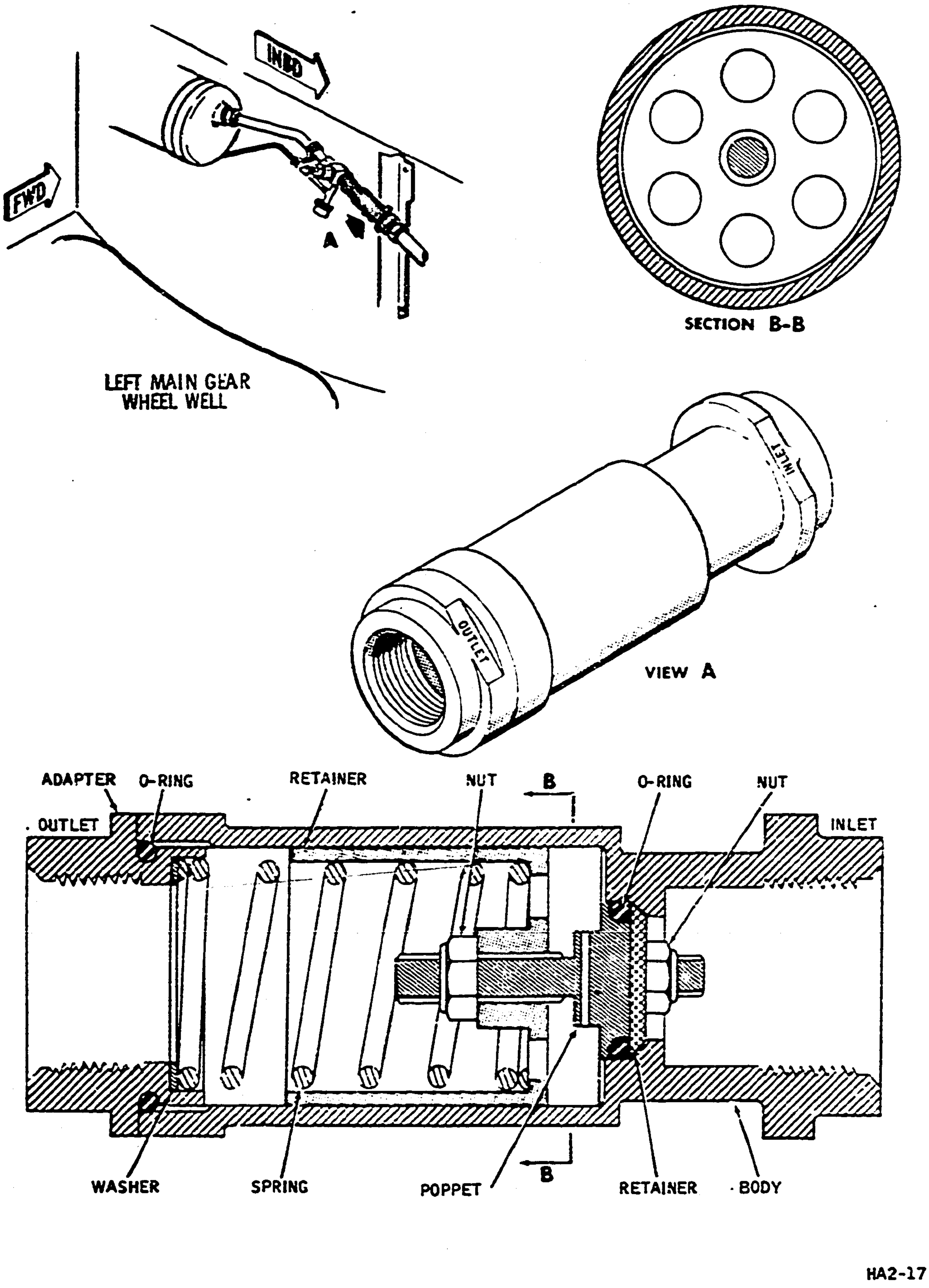
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



Hydraulic Reservoir Relief Valve
Figure 7

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

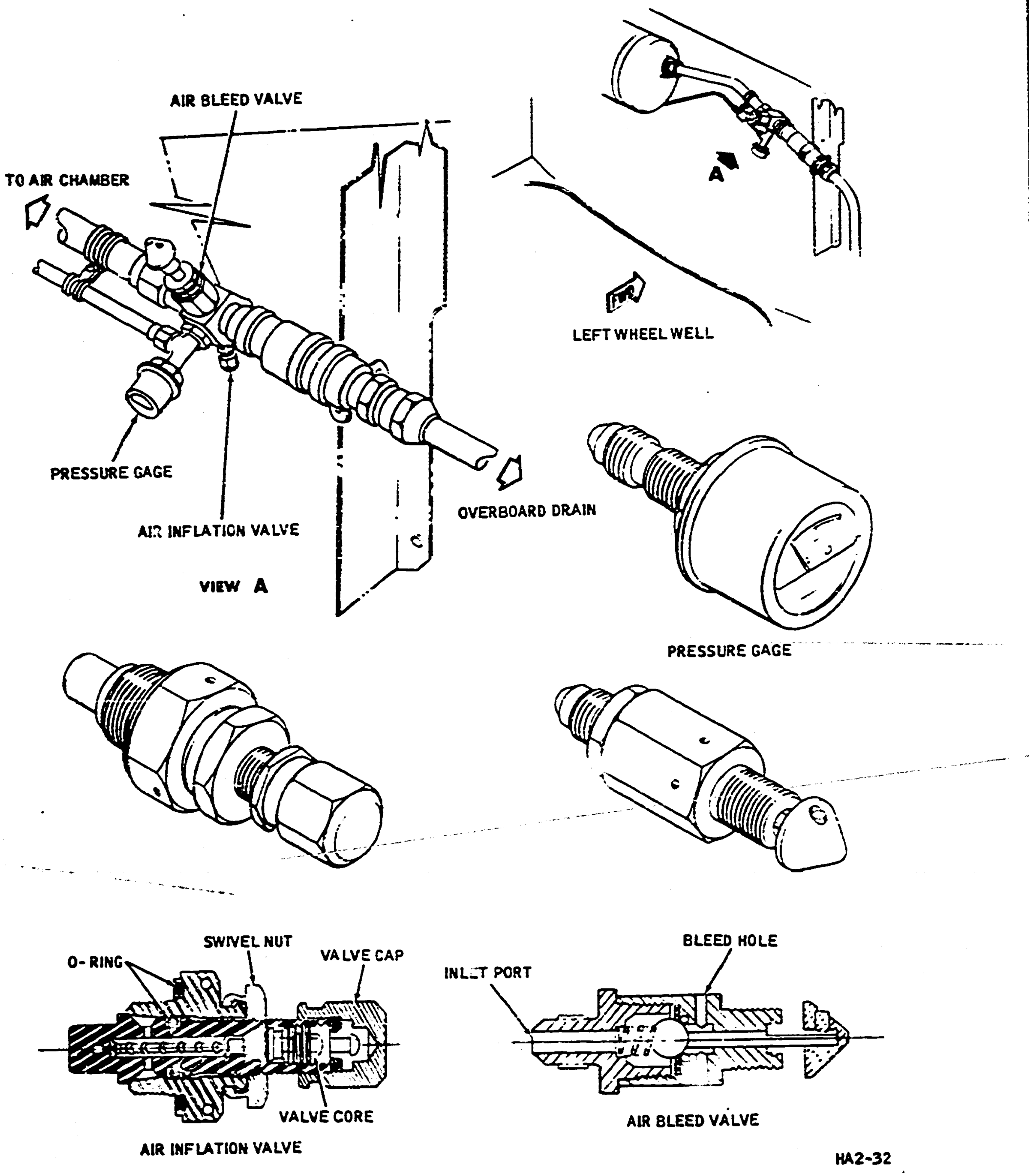
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

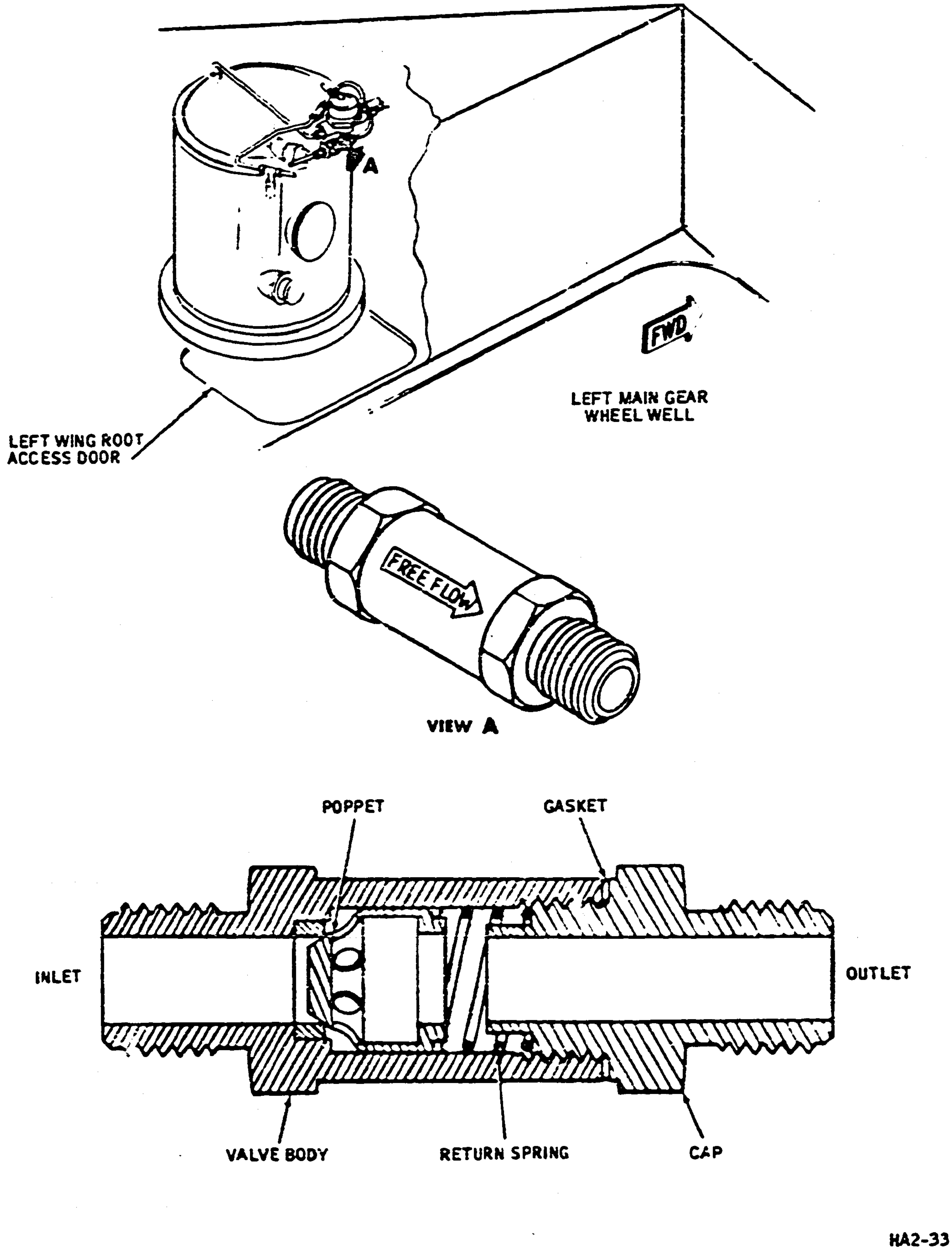
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

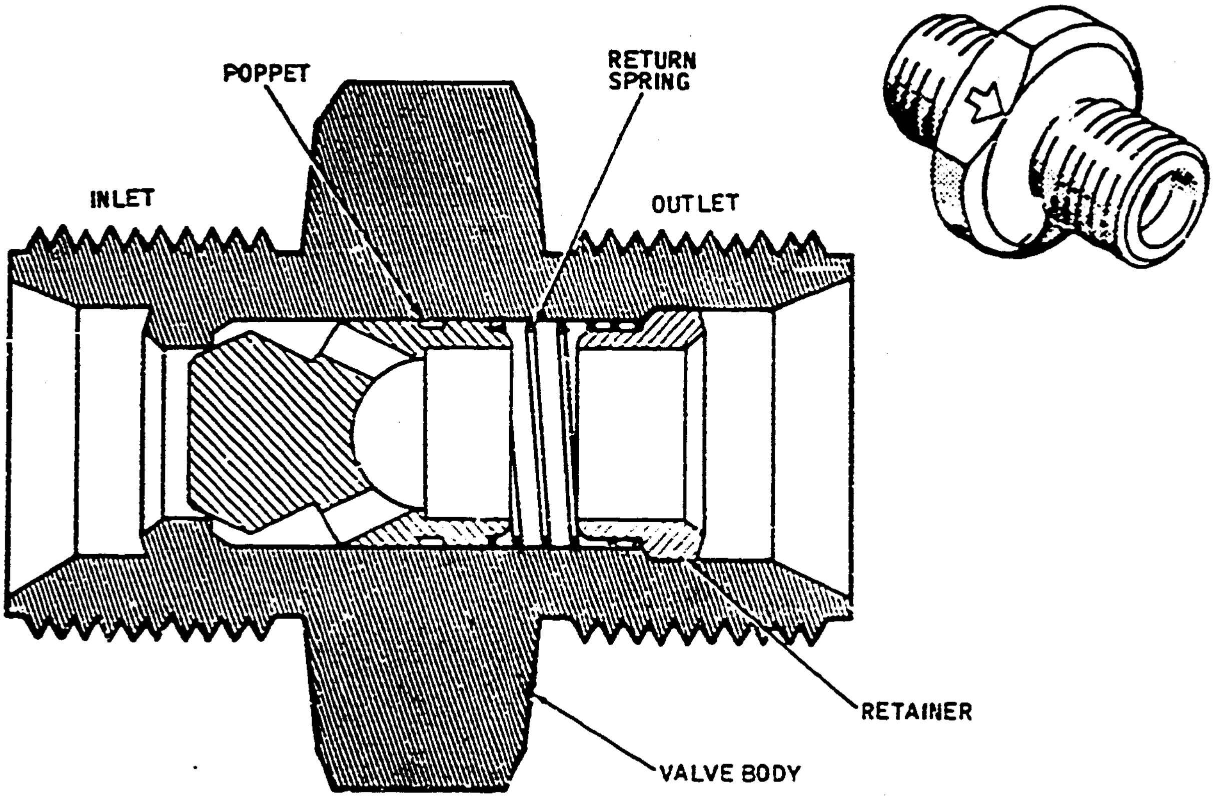
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

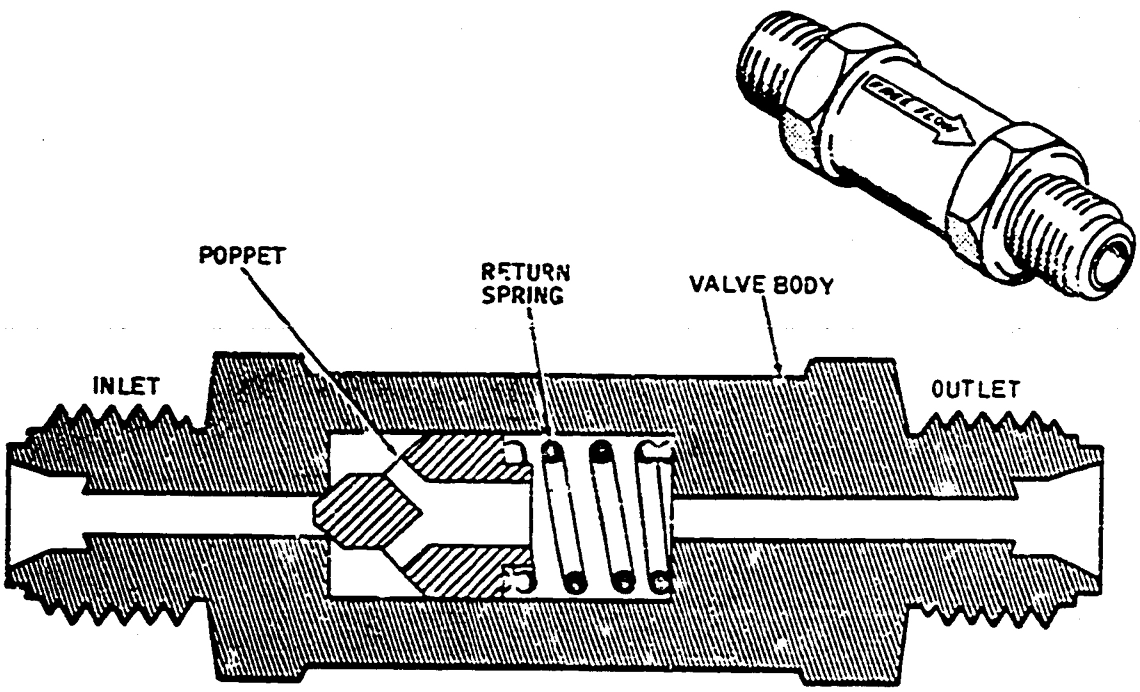
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pre-travel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

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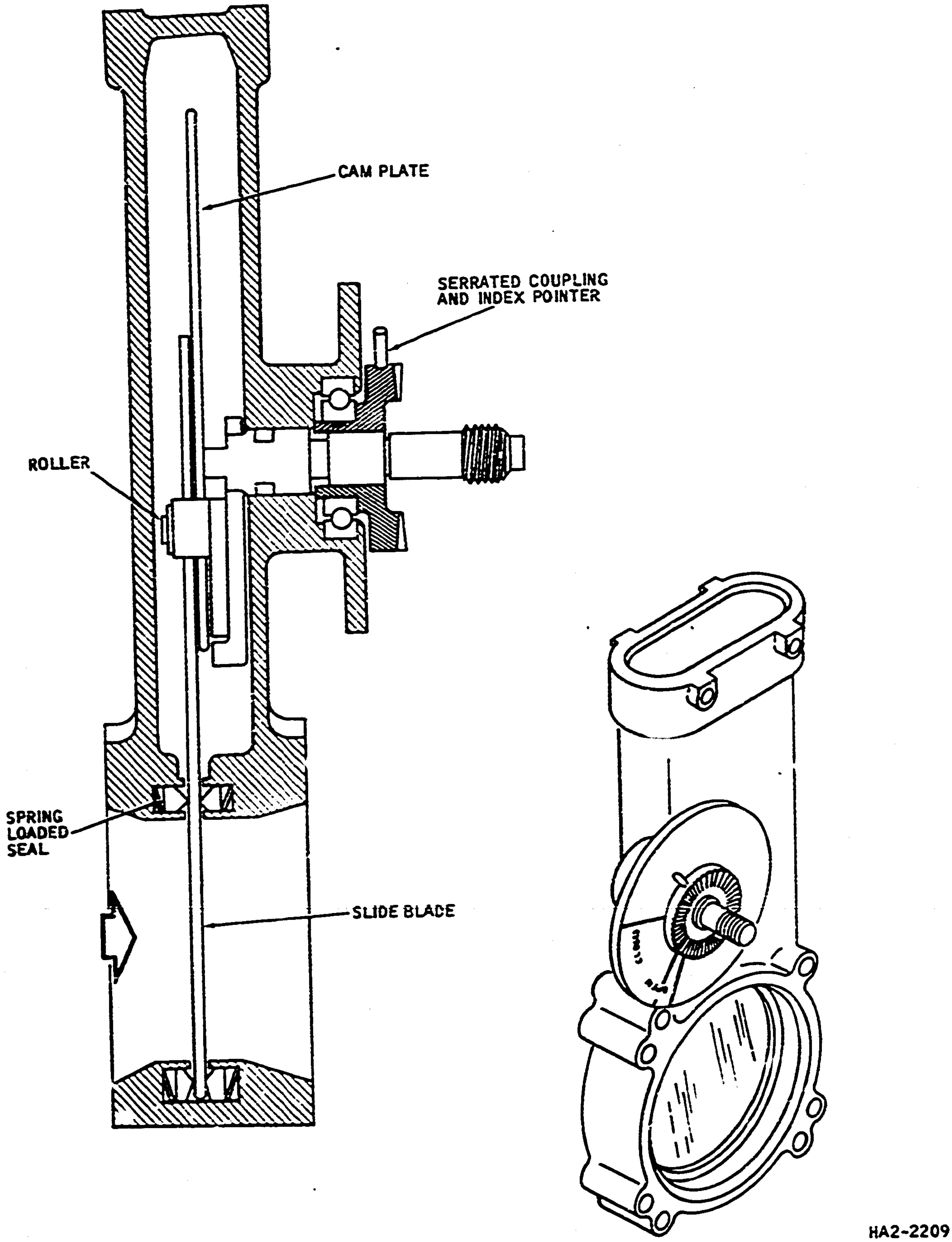
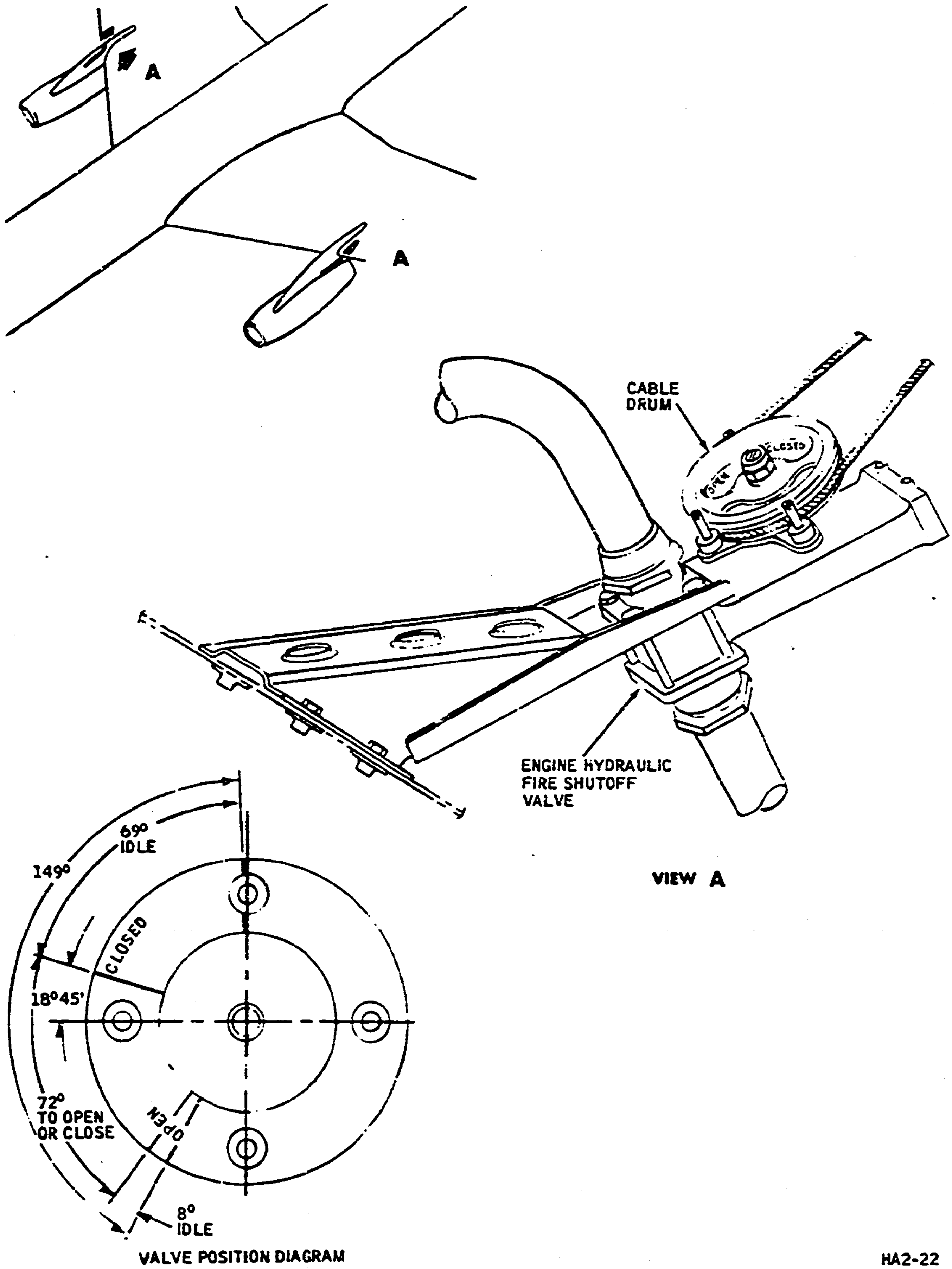
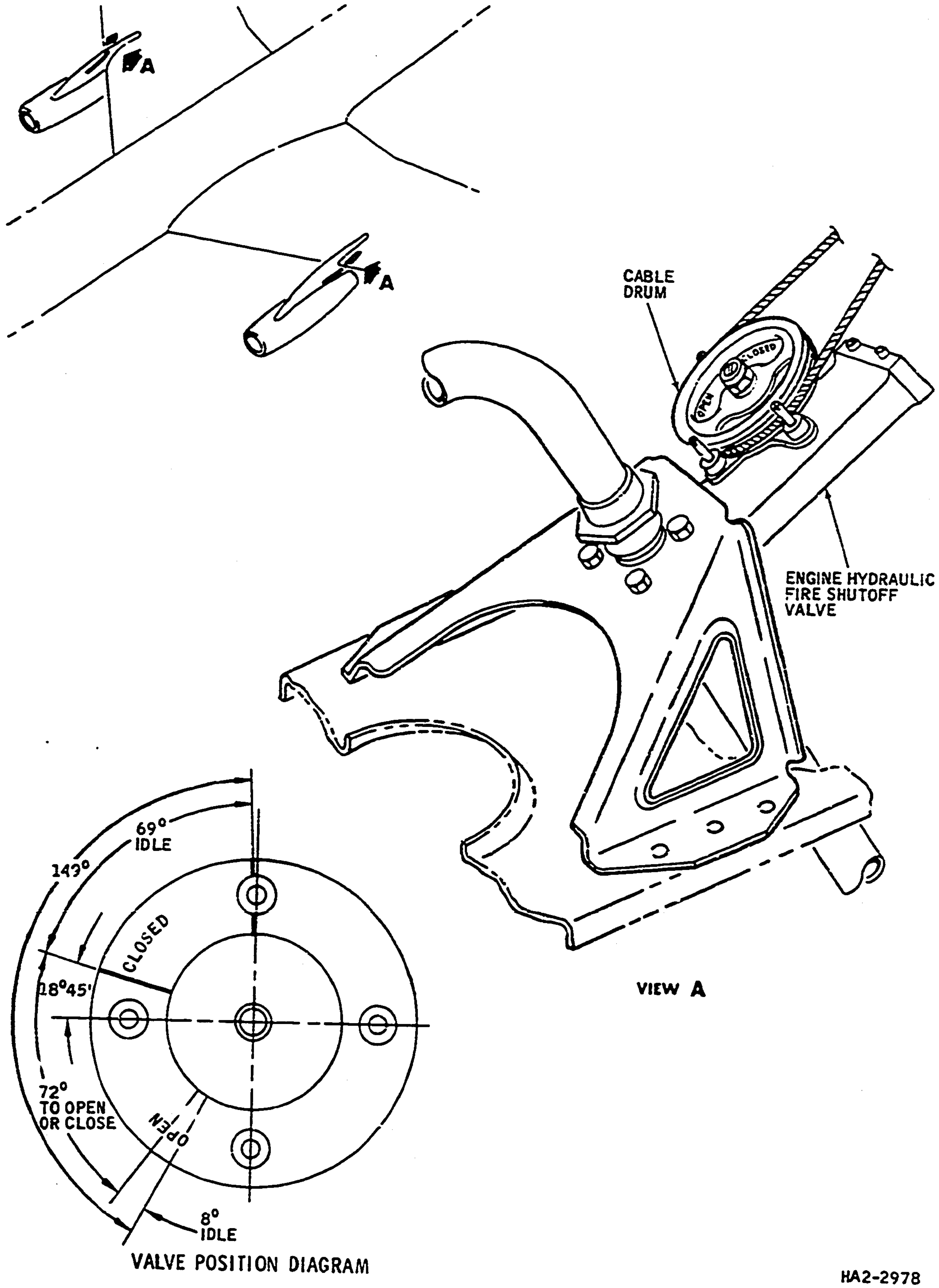
Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
(Airplanes N8762-N8778)
Figure 12 (Sheet 1)



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Engine Hydraulic Fire Shutoff Valve
(Airplanes N8755-N8760)
Figure 12 (Sheet 2)

positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

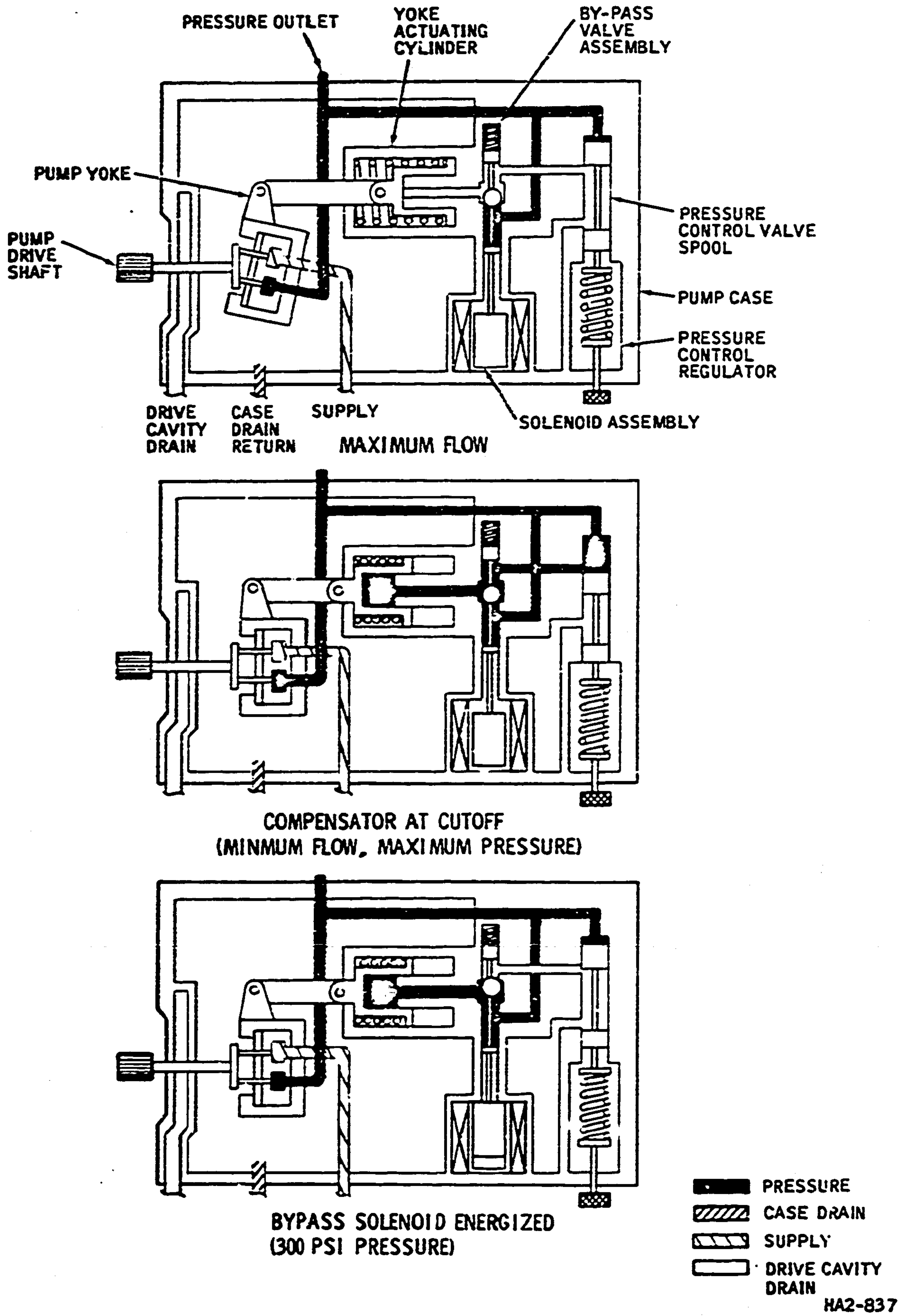
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handles for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low-pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an



Engine-Driven Hydraulic Pump Pressure Flow -- Schematic
Figure 13

electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. If the engine-driven hydraulic pump control switches are in the on position, and the output pressure of either pump drops below 1500 psi, an amber light located in the flight compartment comes on.

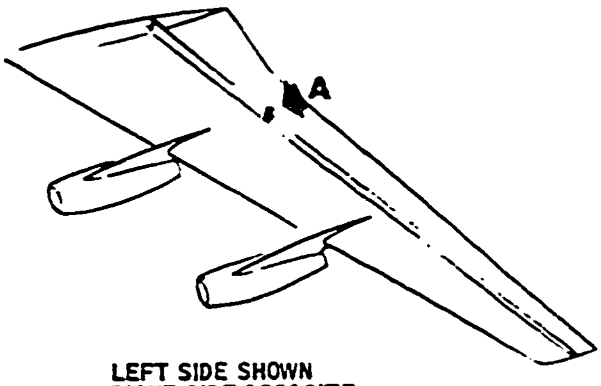
L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

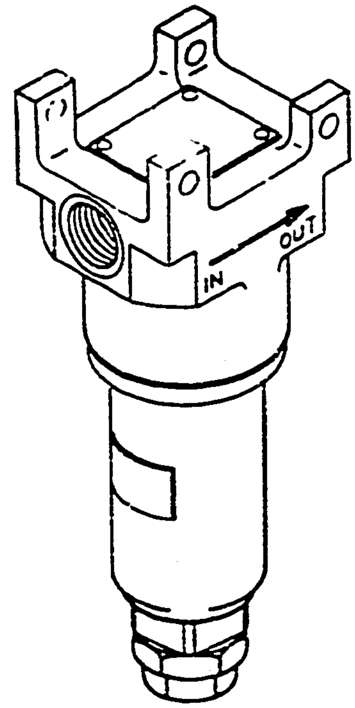
(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

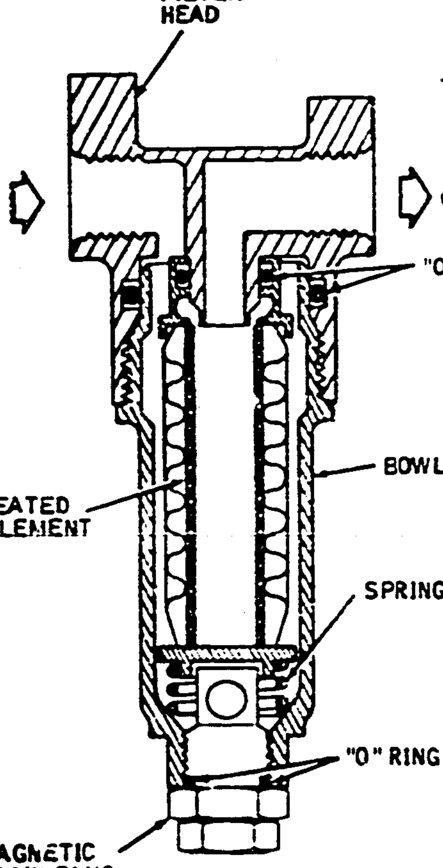
M. Engine-Driven Hydraulic Pump Case Drai Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear





VIEW A



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Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

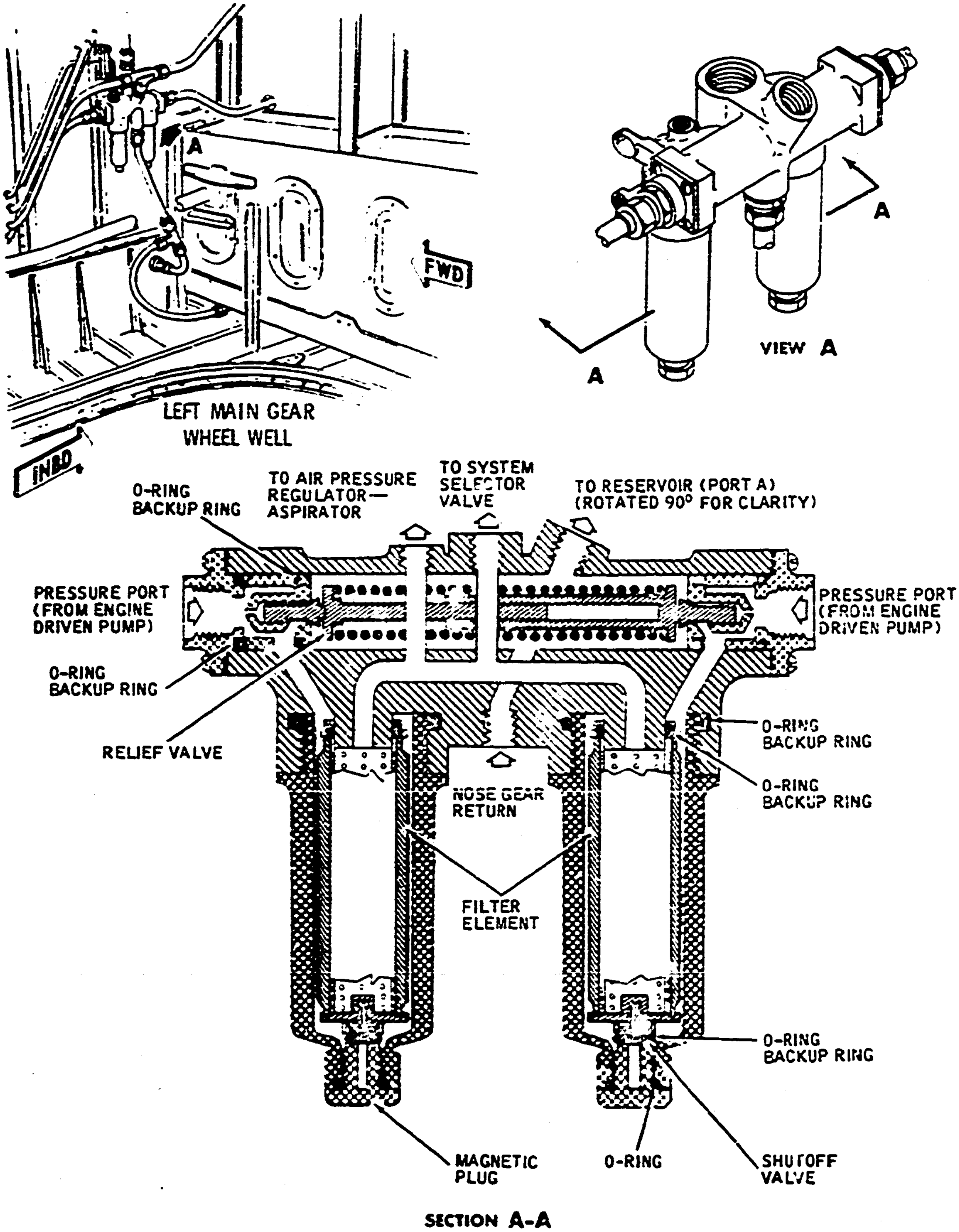
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



Dual Filter and Relief Valve -- Cutaway View
Figure 15

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

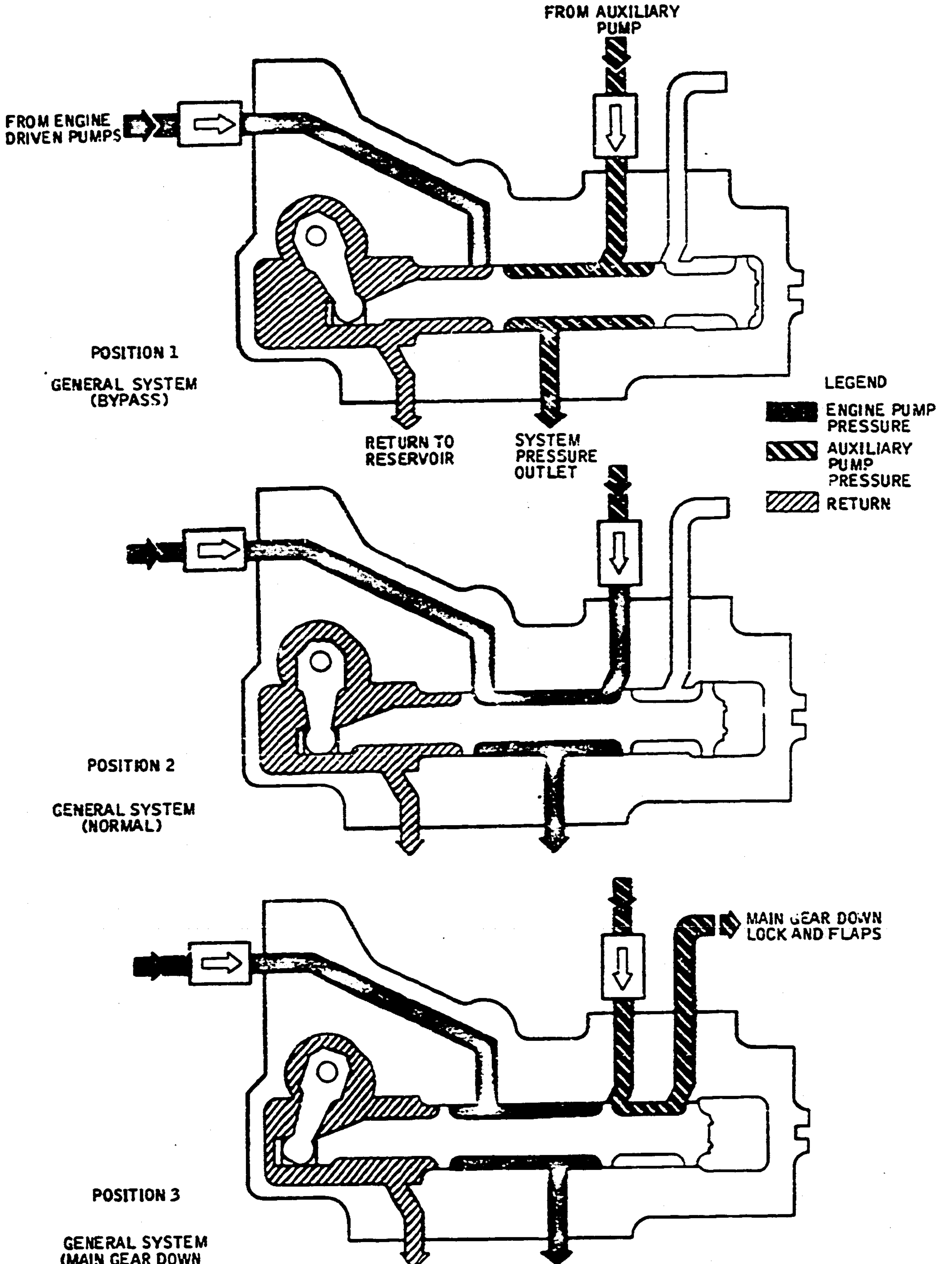
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

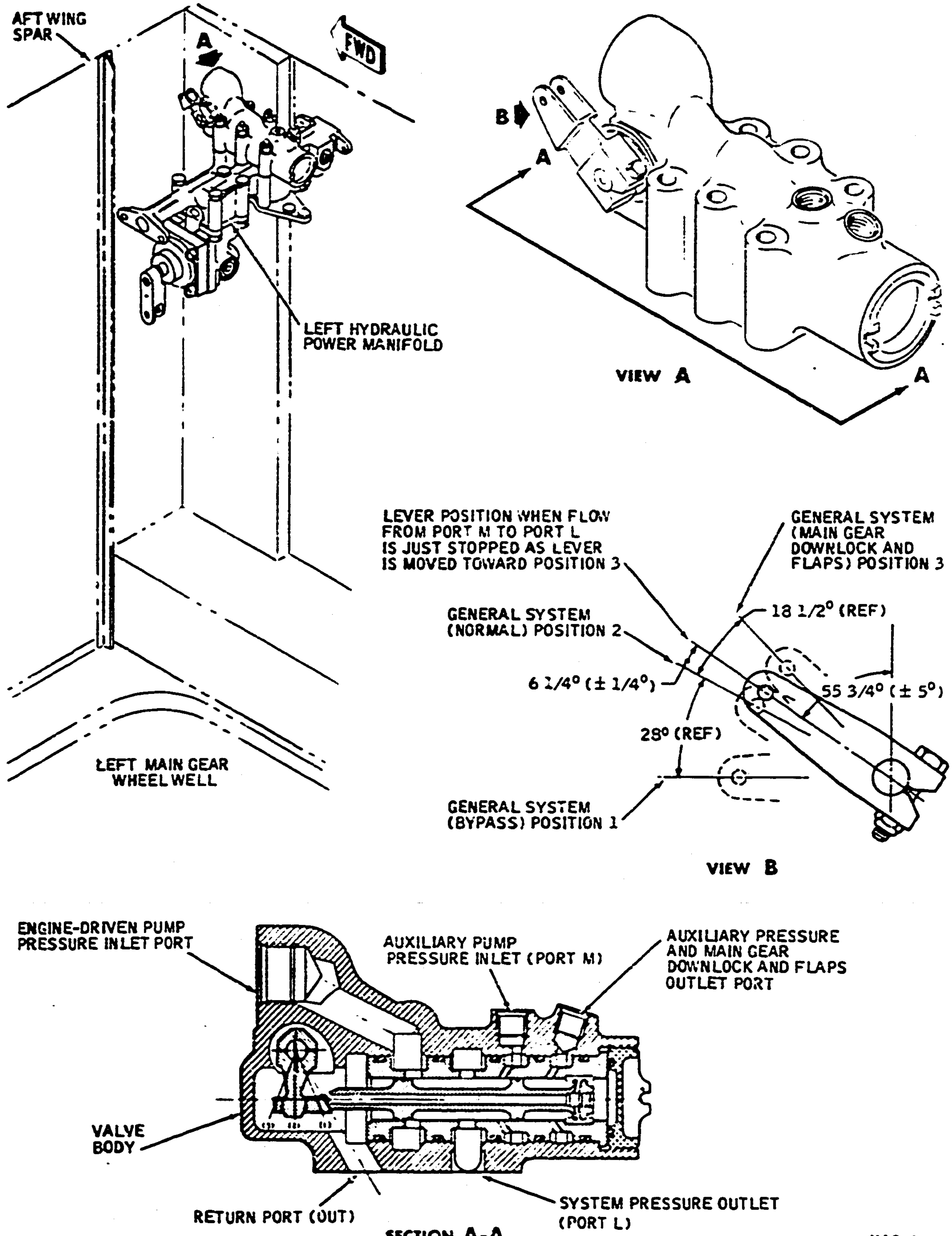
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

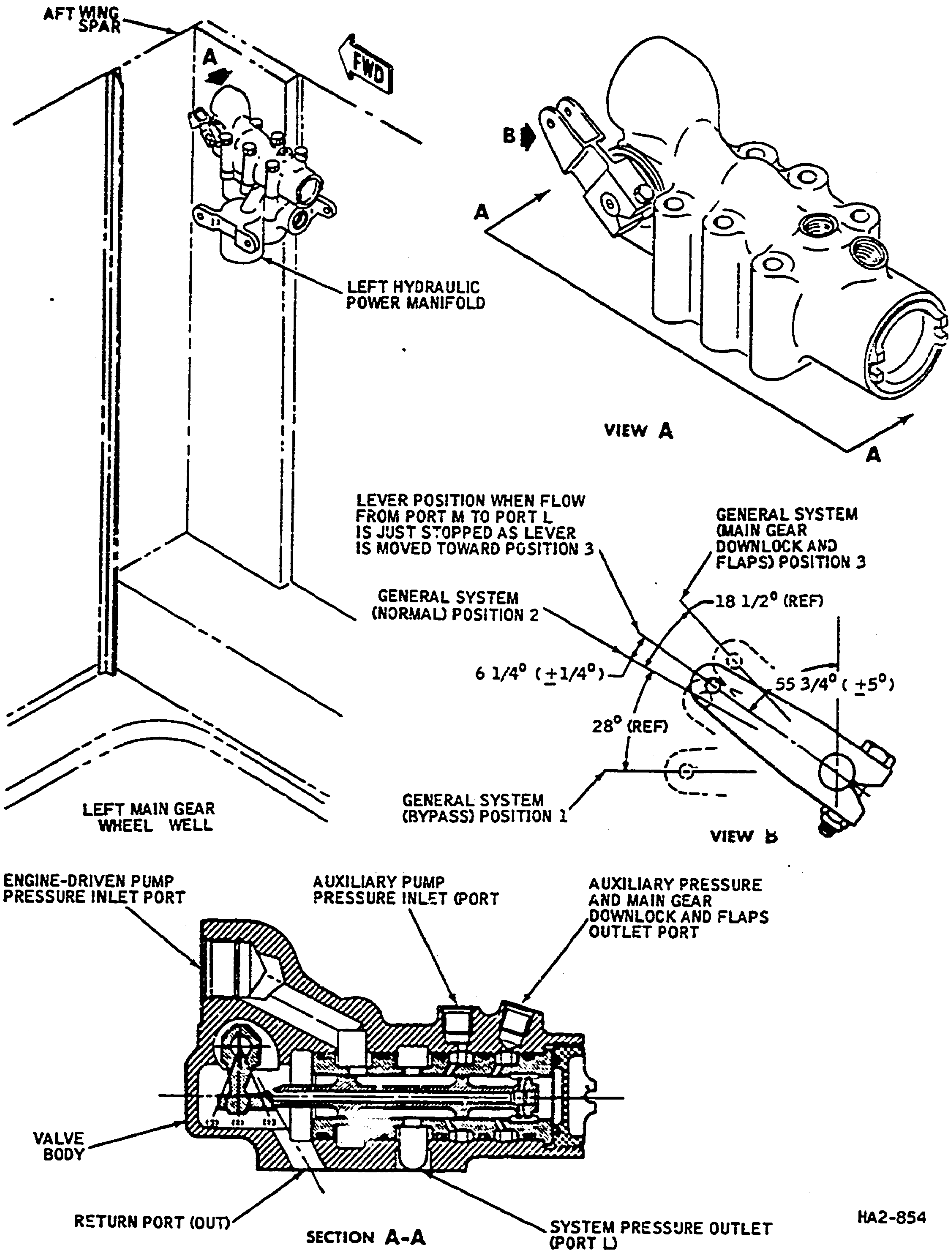
(2) On airplanes N8762-N8778, three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two



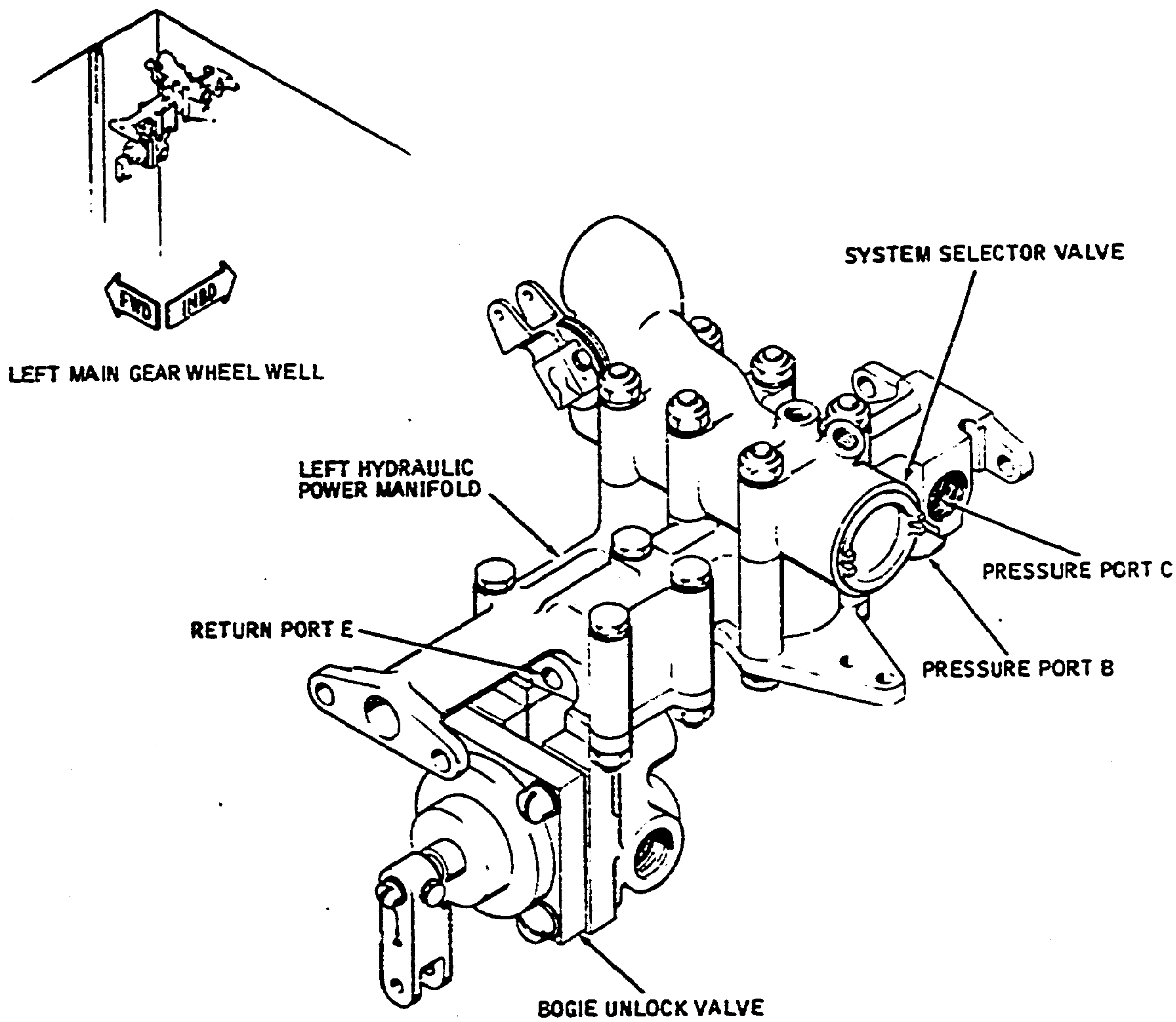
System Selector Valve -- Schematic
Figure 16

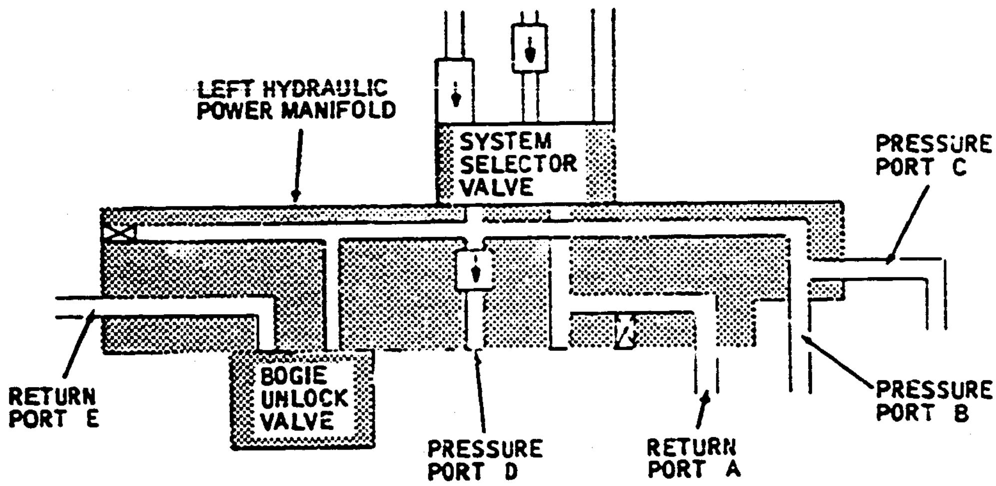


System Selector Valve -- Cutaway View
(Airplanes N8762-N8778)
Figure 17 (Sheet 1)



System Selector Valve -- Cutaway View
(Airplanes N8755-N8760)
Figure 17 (Sheet 2)





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Left Hydraulic Power Manifold -- Schematic
(Airplanes N8762-N8778)
Figure 18 (Sheet 1)

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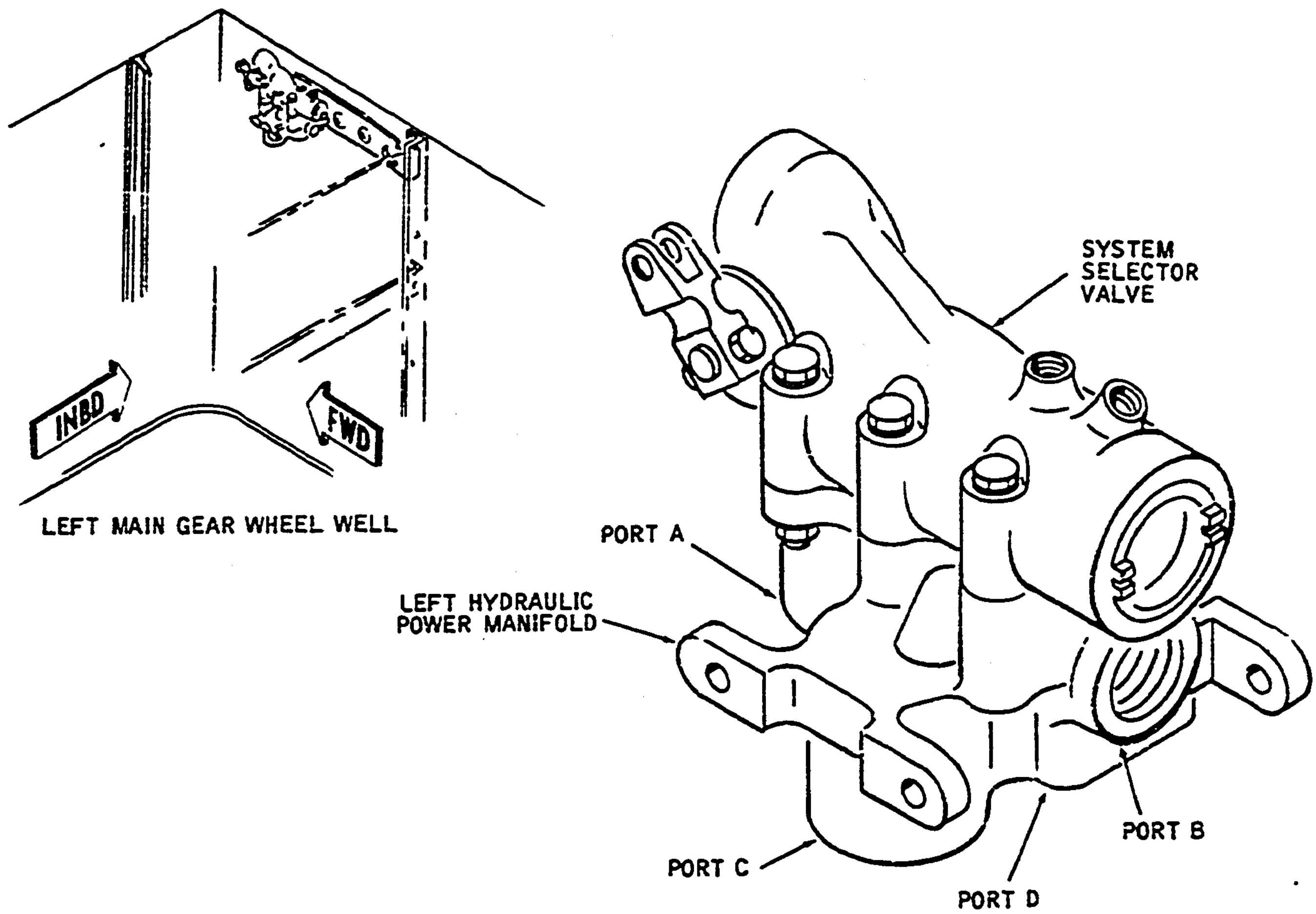
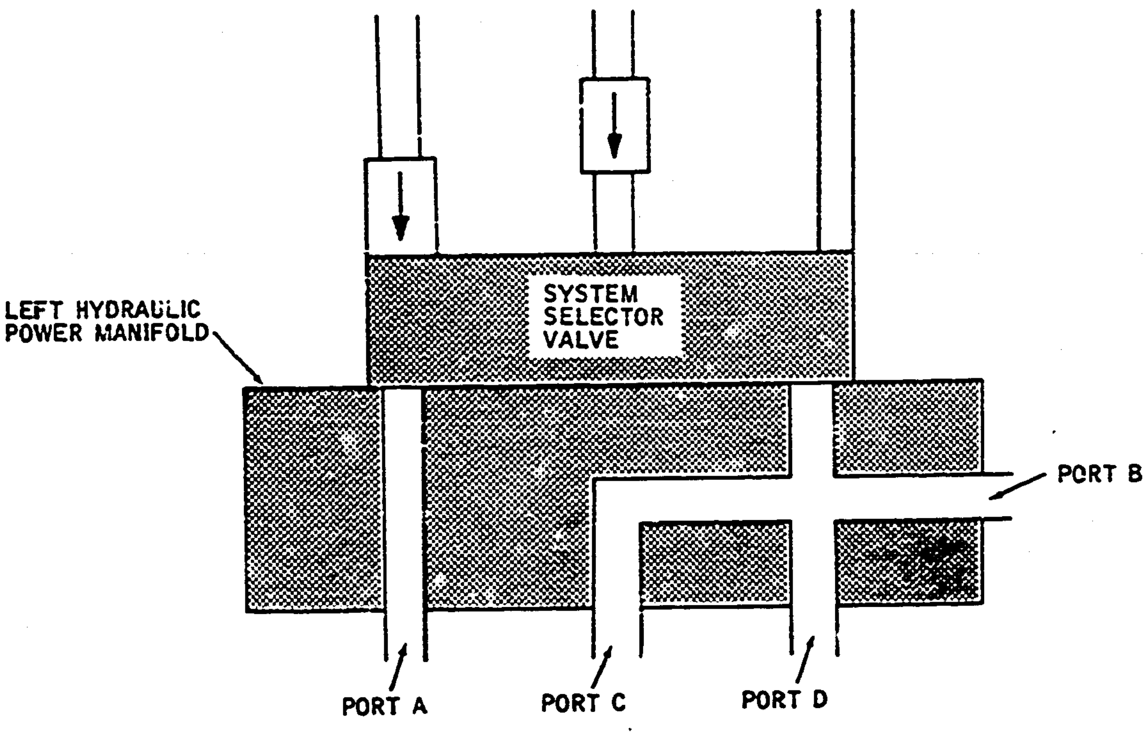




HA2-855

Left Hydraulic Power Manifold -- Schematic
(Airplanes N8755-N8760)
Figure 18 (Sheet 2)

ports are return outlets, located immediately forward of the manifold pressure outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

(3) On airplanes N8755-N8760, one valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

Q. Right Hydraulic Power Manifold (See Figure 19.)

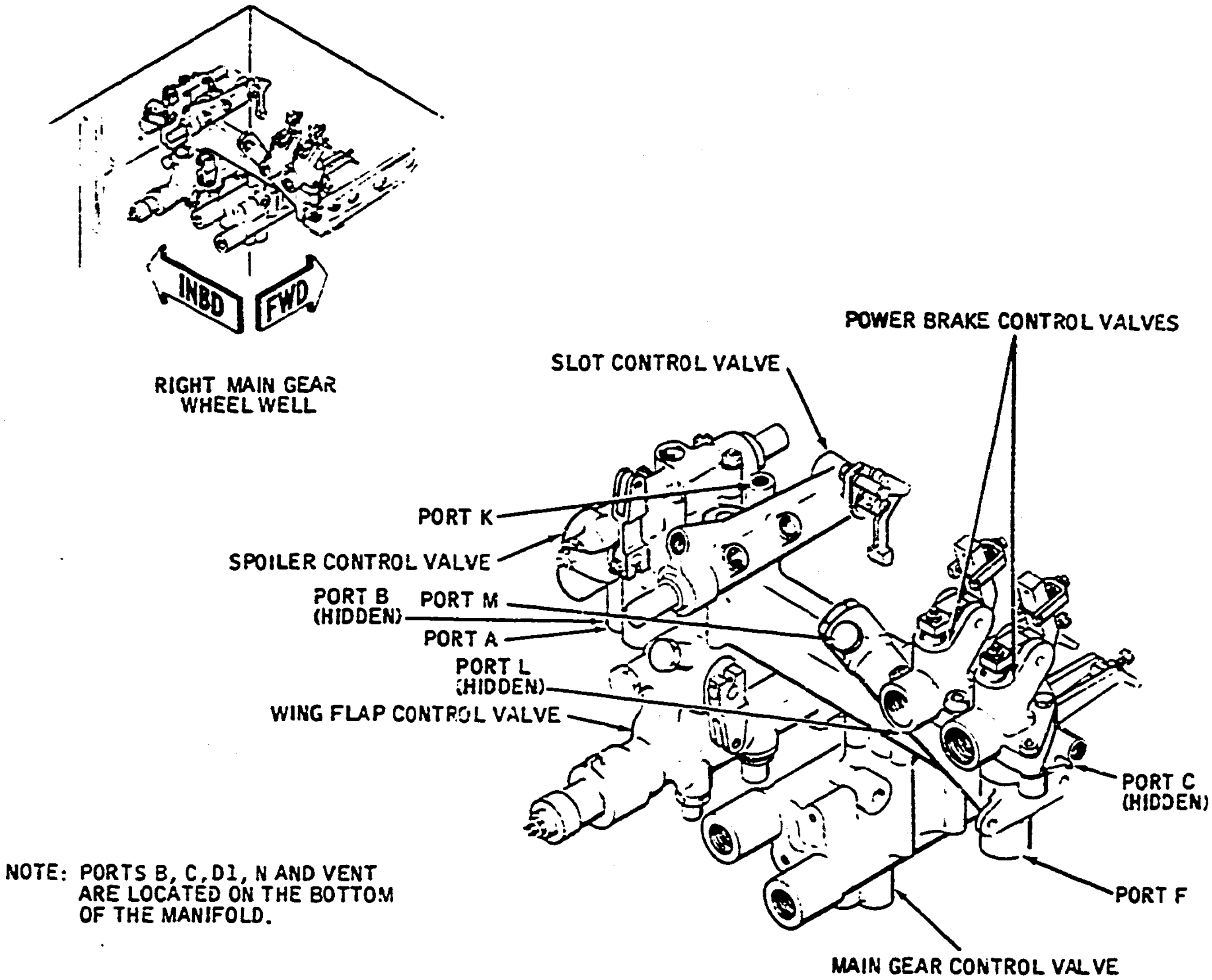
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

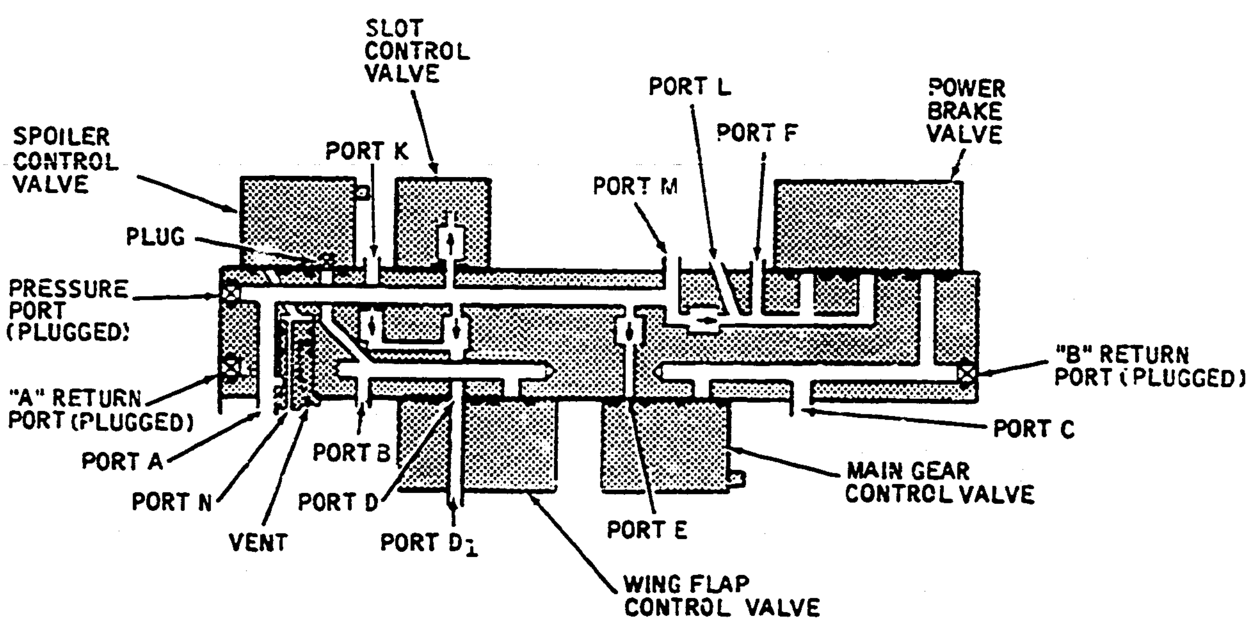
(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the





Right Hydraulic Power Manifold -- Schematic
Figure 19

reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Hydraulic Manifold Return Check Valves (Airplanes N8762-N8778, See Figure 10.)

(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.

S. Hydraulic Power System Accumulator (See Figure 20.)

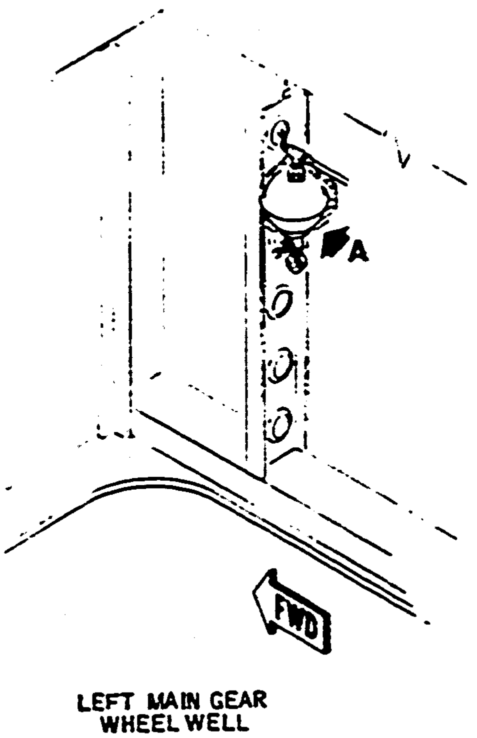
(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

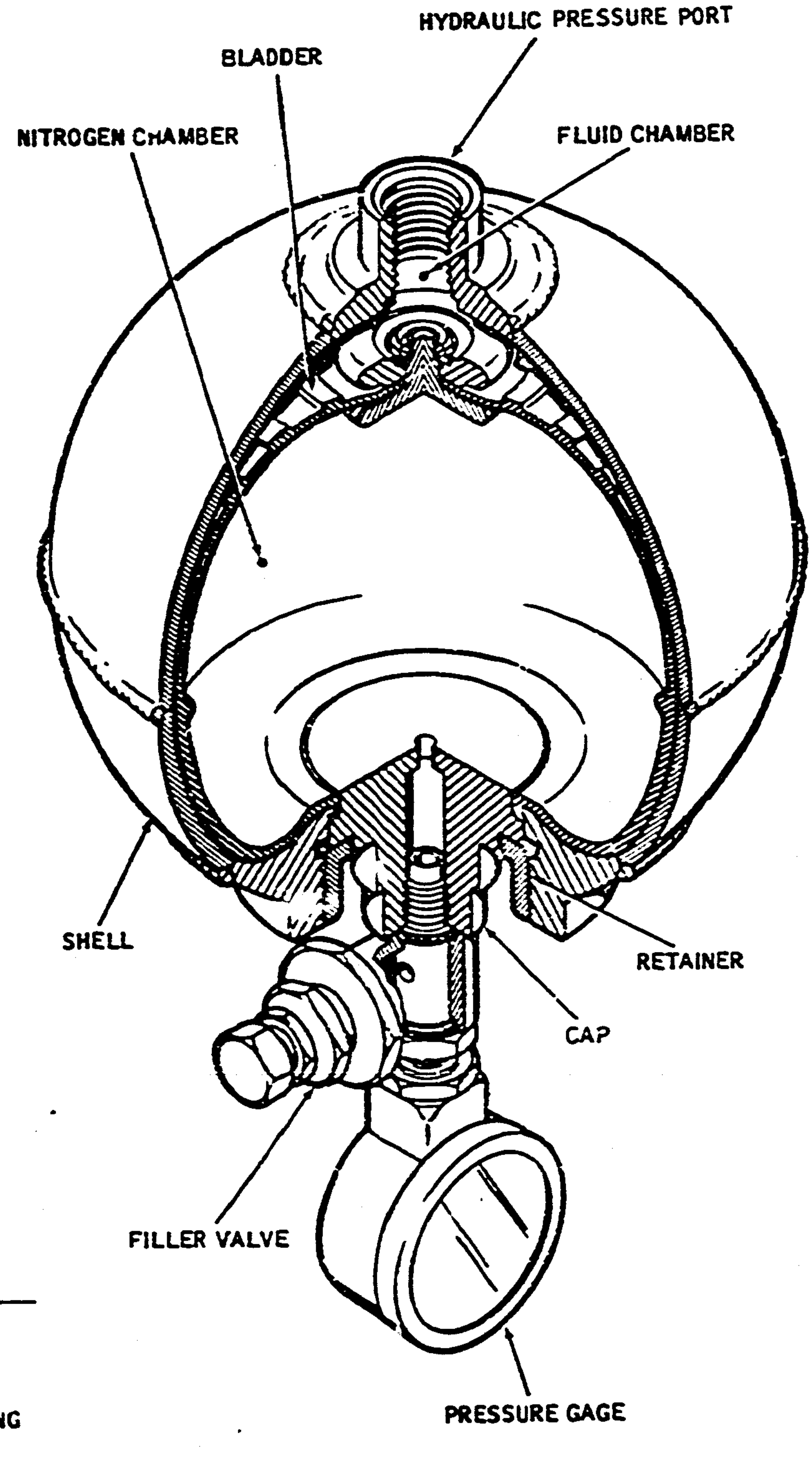
(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

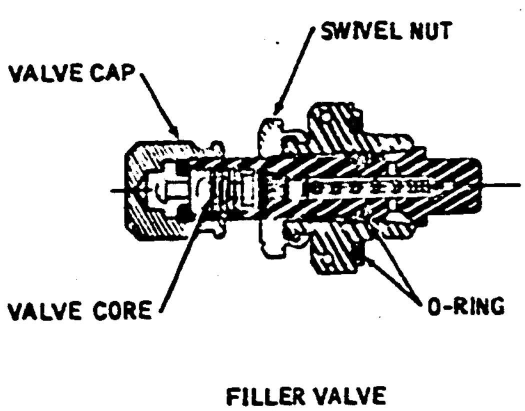
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is venter to ambient air through a breather hole which is covered by a butyl rubber band.







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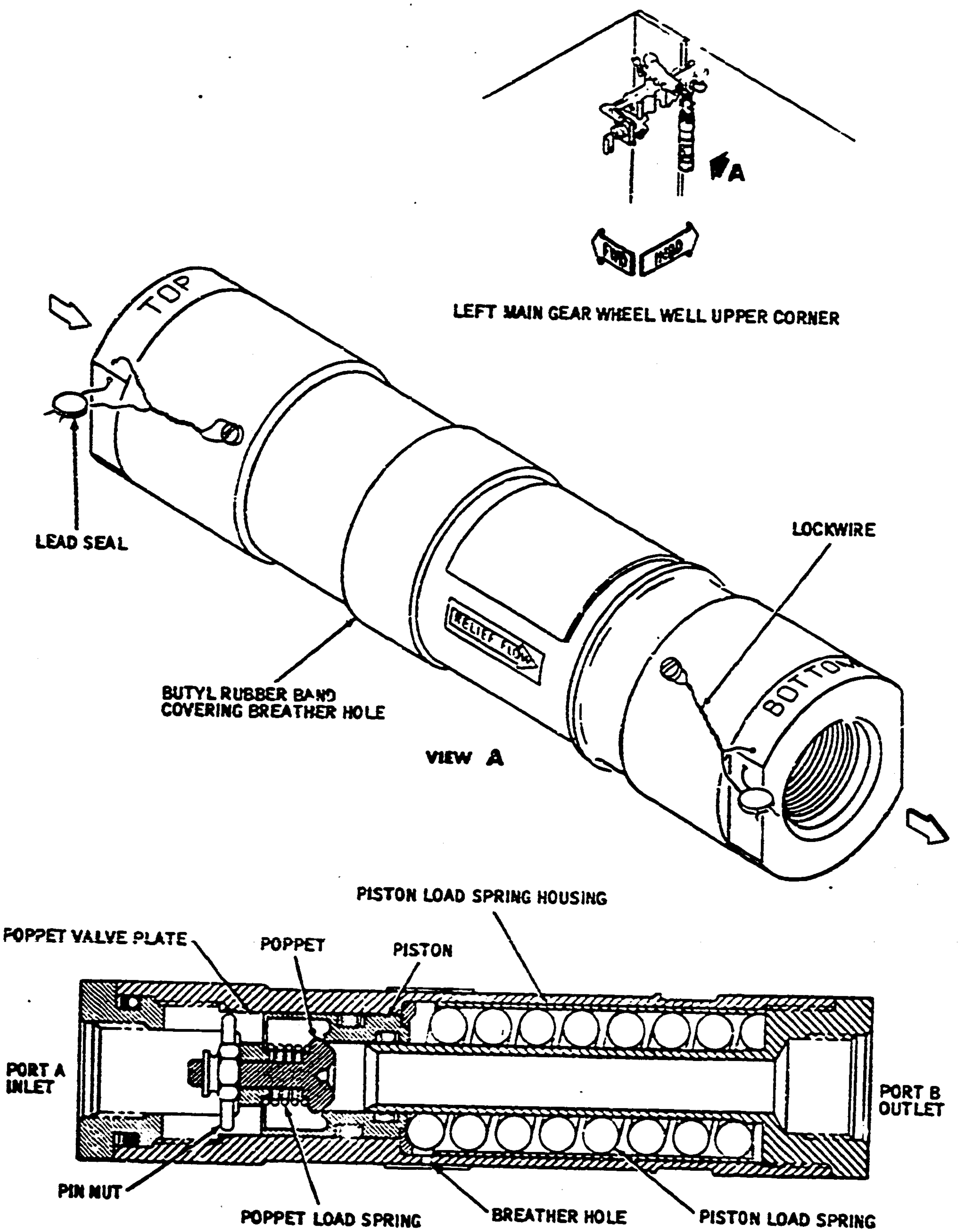
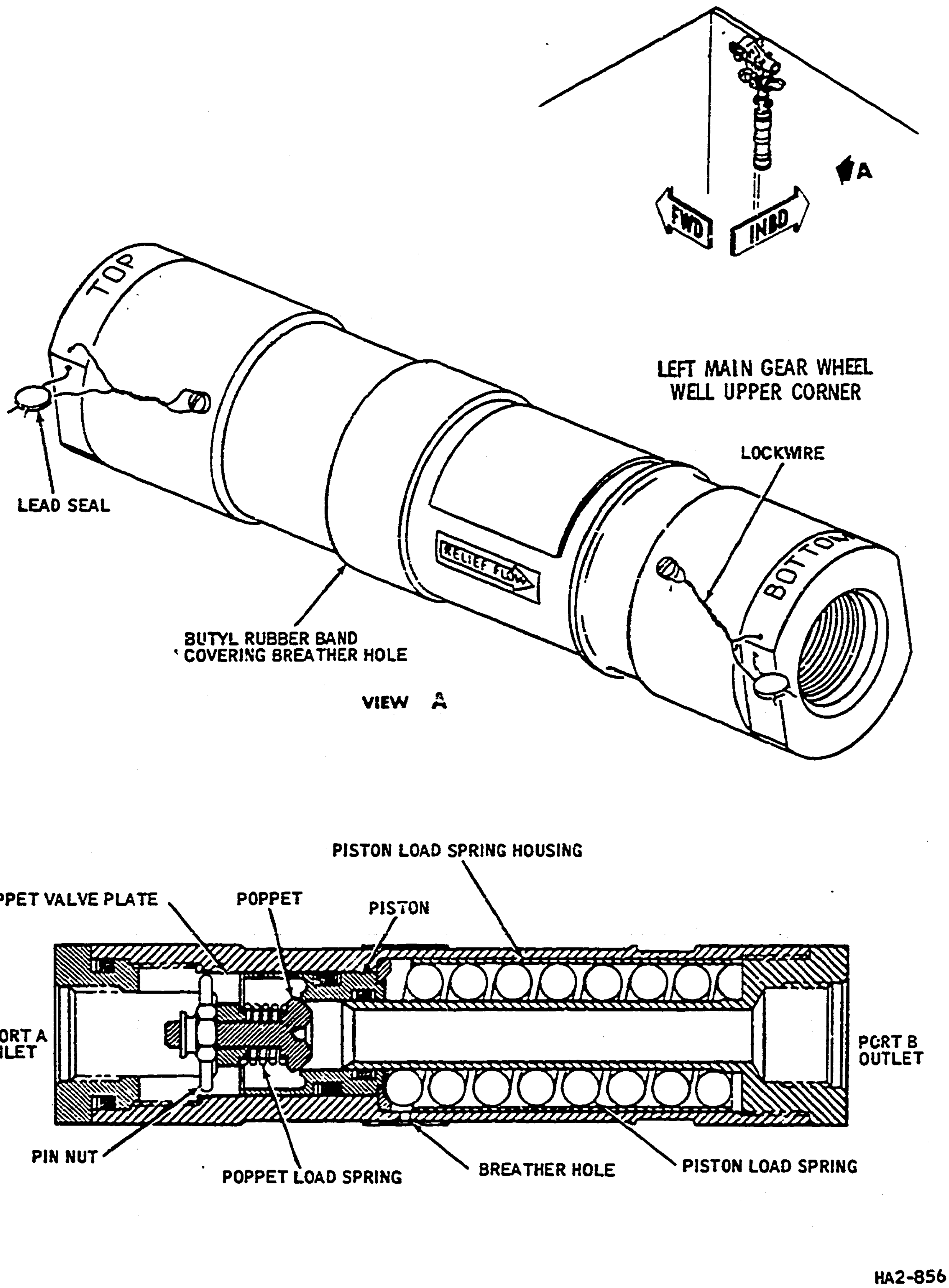
Hydraulic Power System Accumulator -- Cutaway View
Figure 20



HA2-34

Hydraulic System Priority Valve -- Cutaway View
(Airplanes N8762-N8778)
Figure 21 (Sheet 1)



Hydraulic System Priority Valve -- Cutaway View
(Airplanes N8755-N8760)
Figure 21 (Sheet 2)

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector

valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

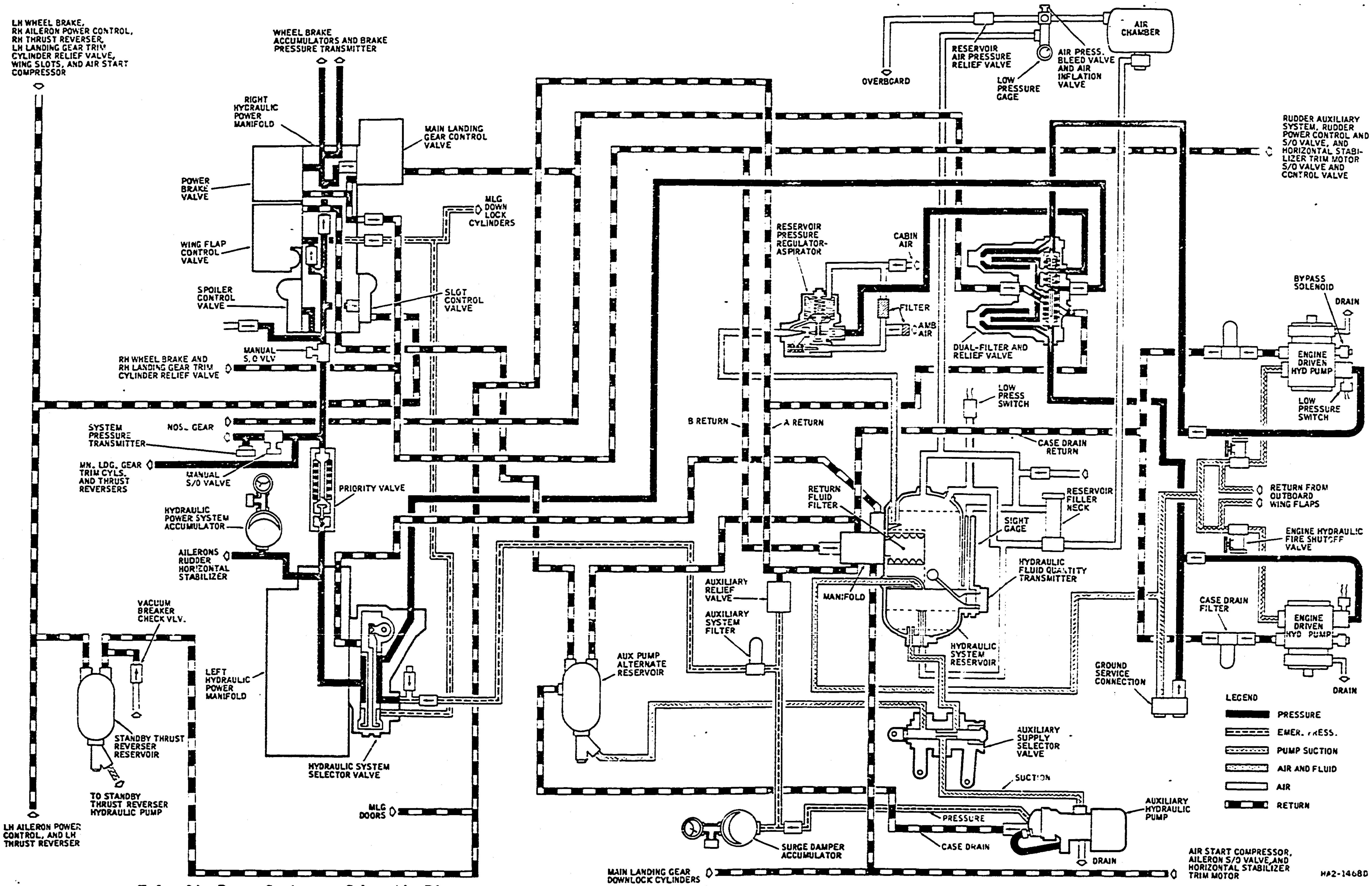
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

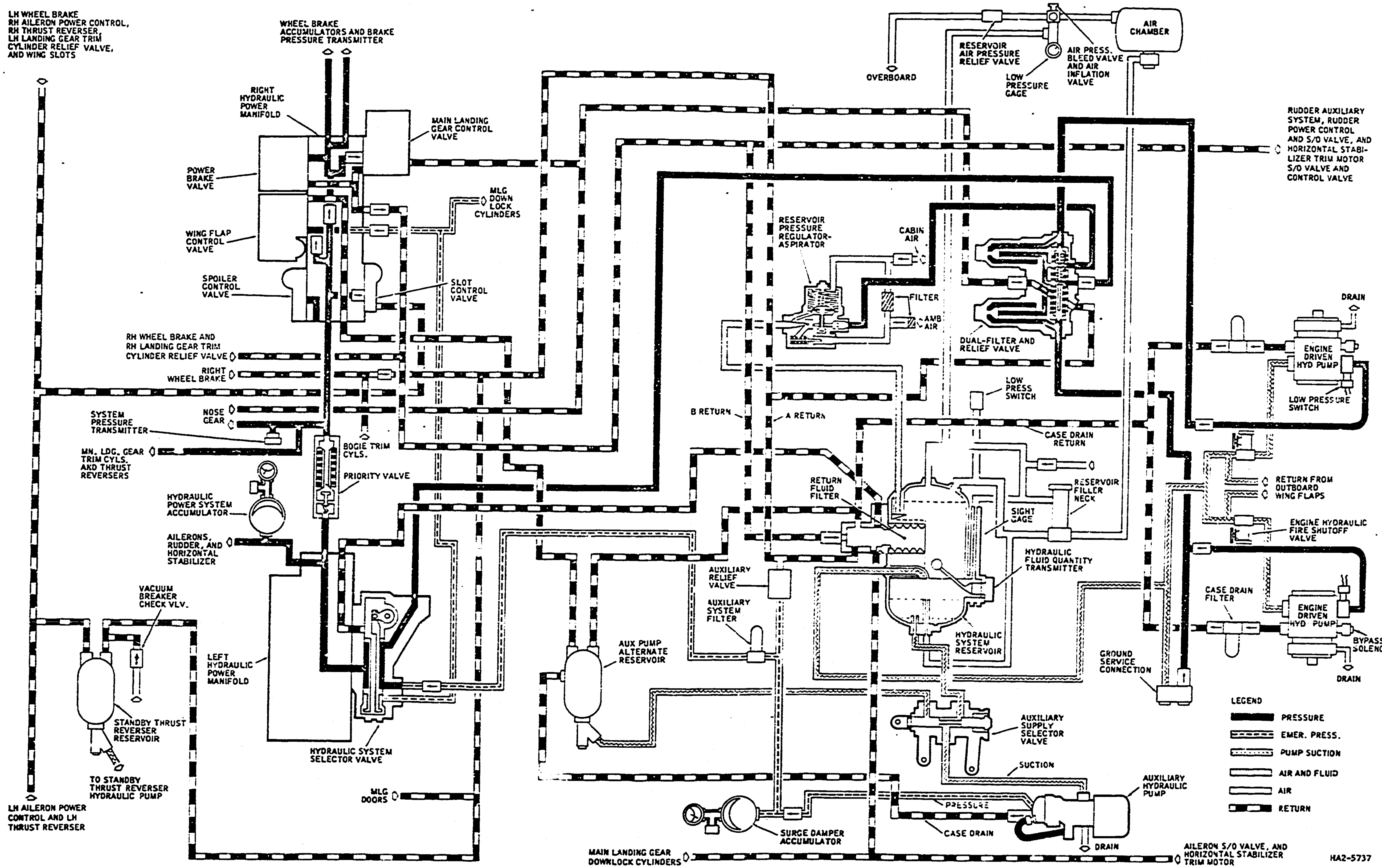
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet



Hydraulic Power System -- Schematic Diagram
(Airplanes 55-75, 77, 78)
Figure 1 (Sheet 1)



Hydraulic Power System -- Schematic Diagram
(Airplane 76)
Figure 1 (Sheet 2)

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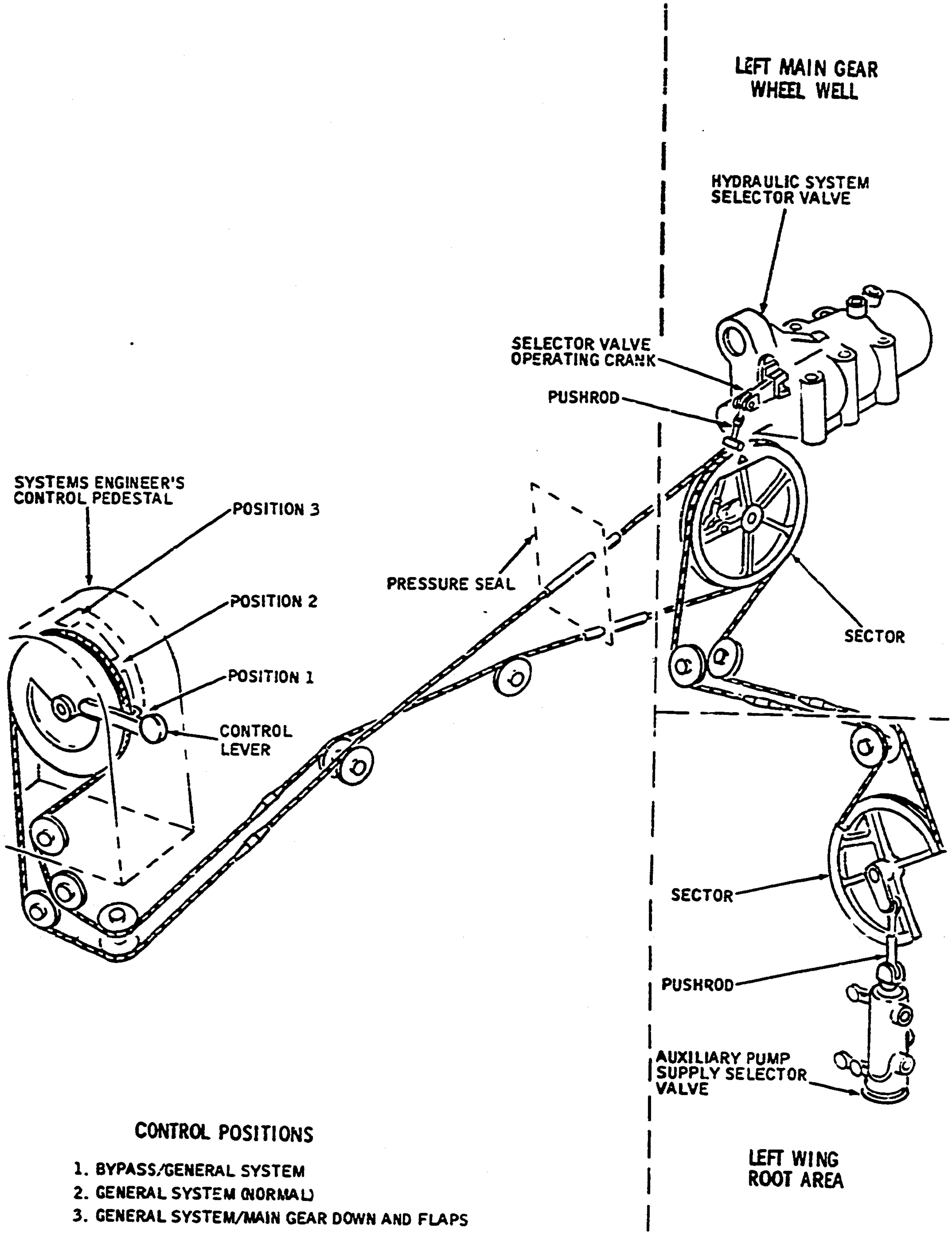


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir

through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

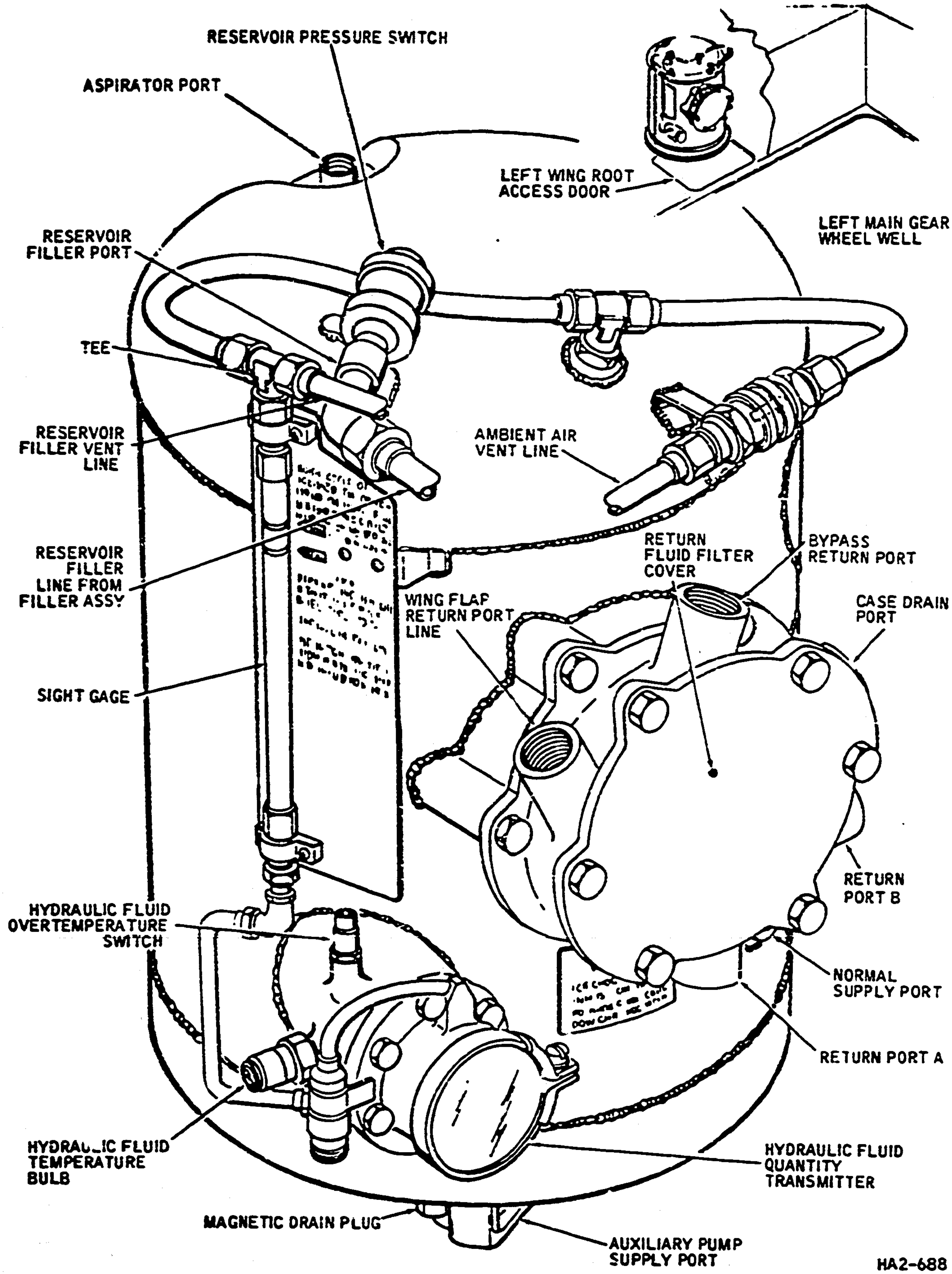
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

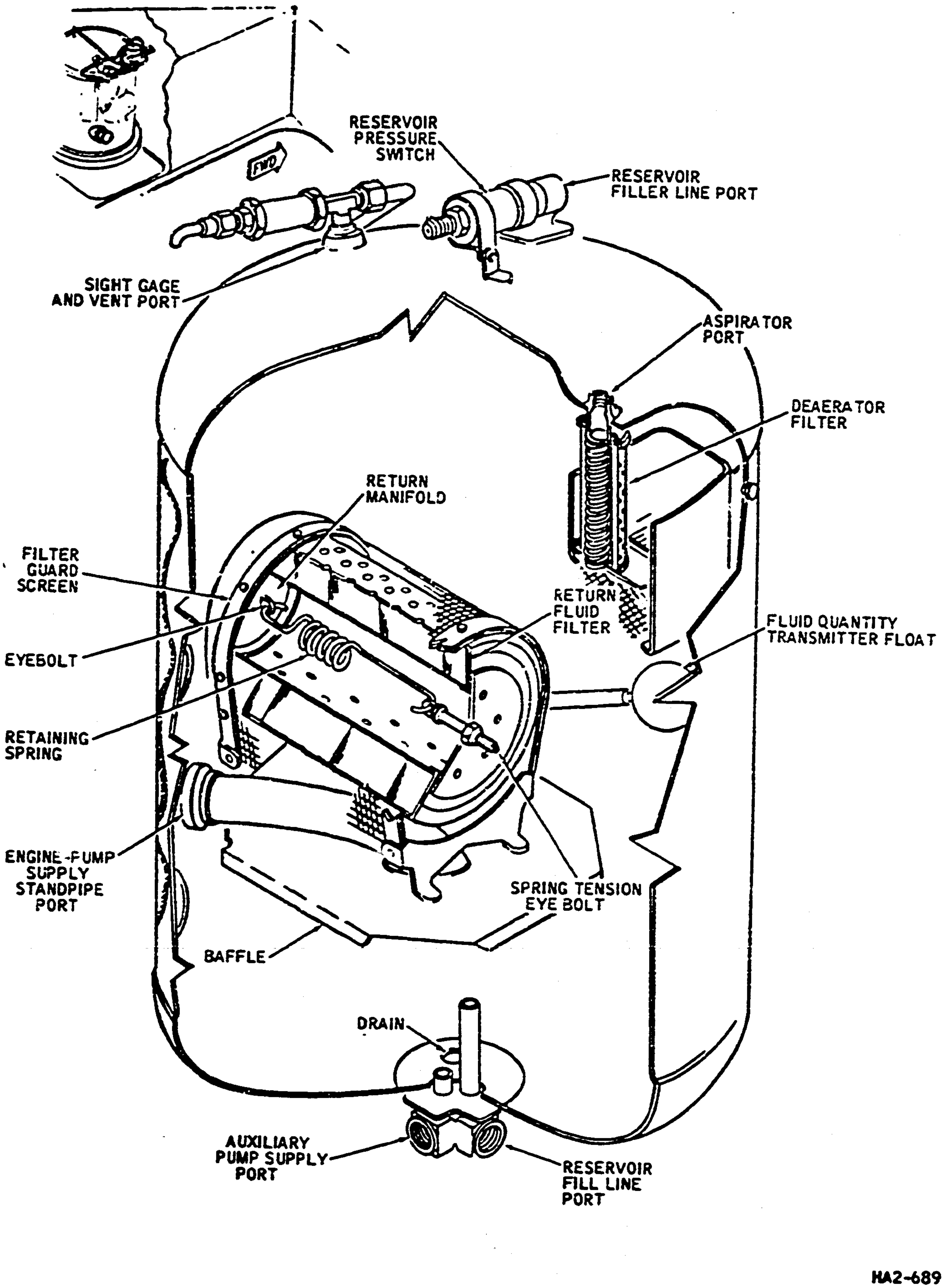
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply.

The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

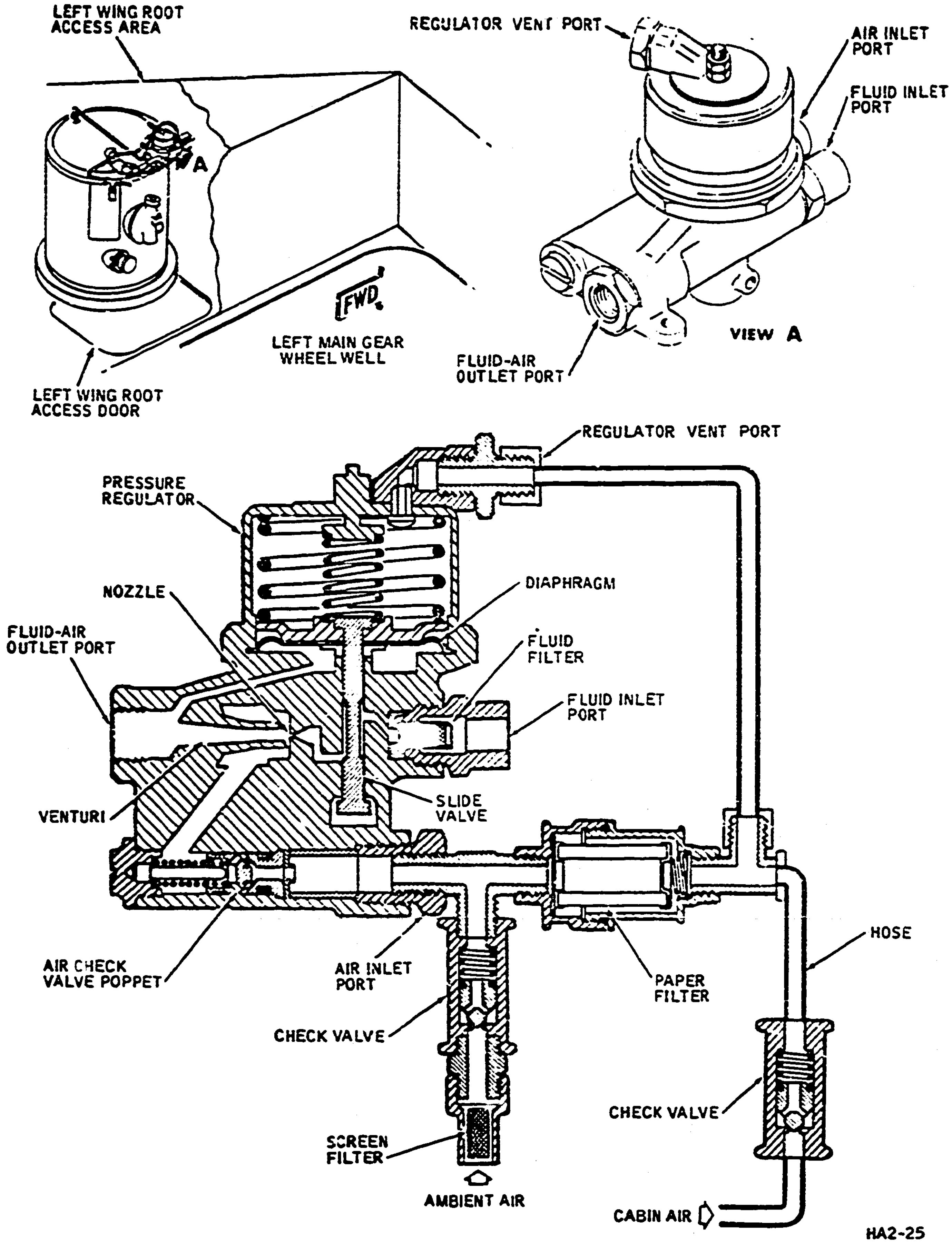
(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet plug. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

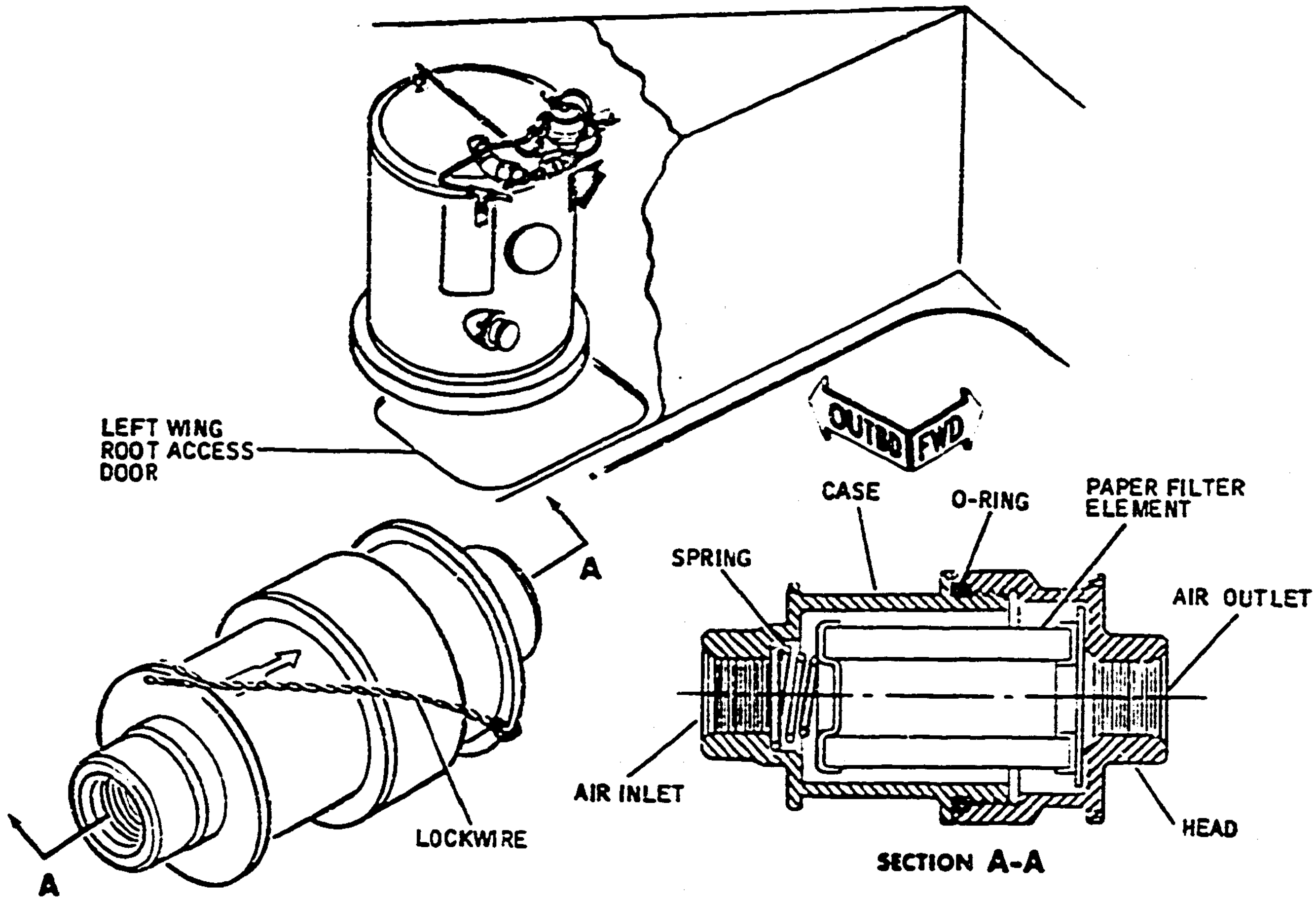
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

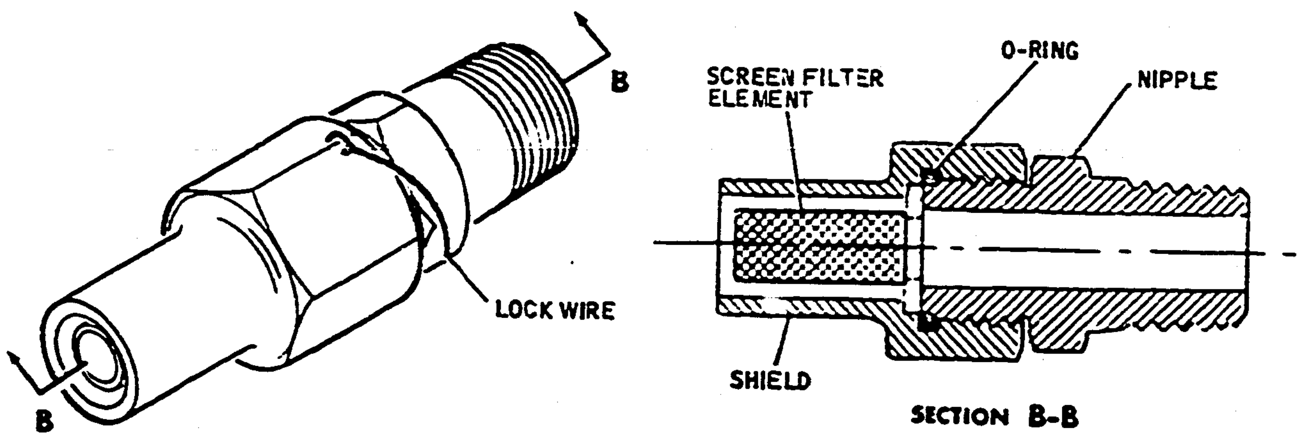
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The outer filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve



PAPER ELEMENT FILTER



SCREEN FILTER

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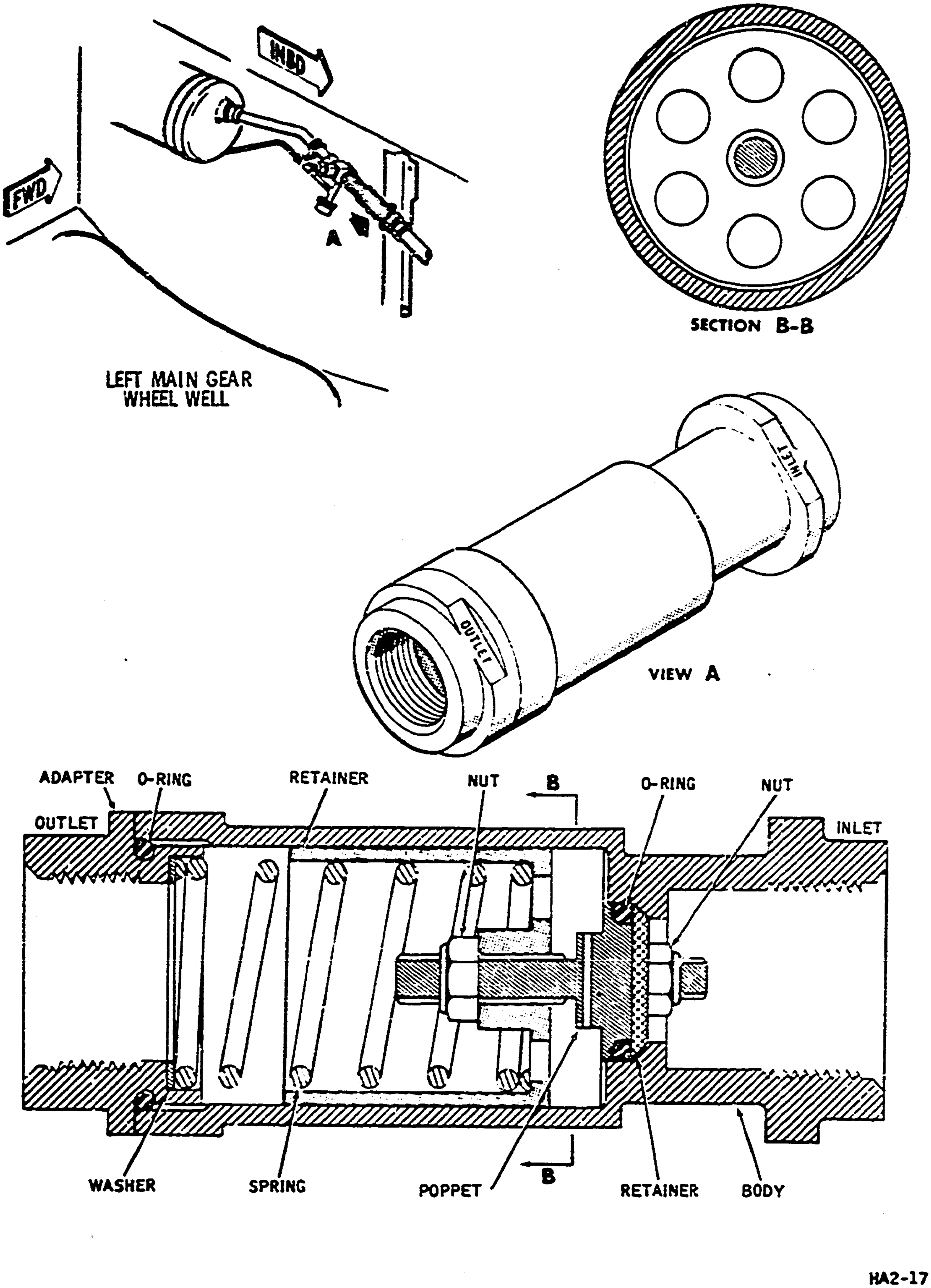
Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



Hydraulic Reservoir Relief Valve
Figure 7

relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

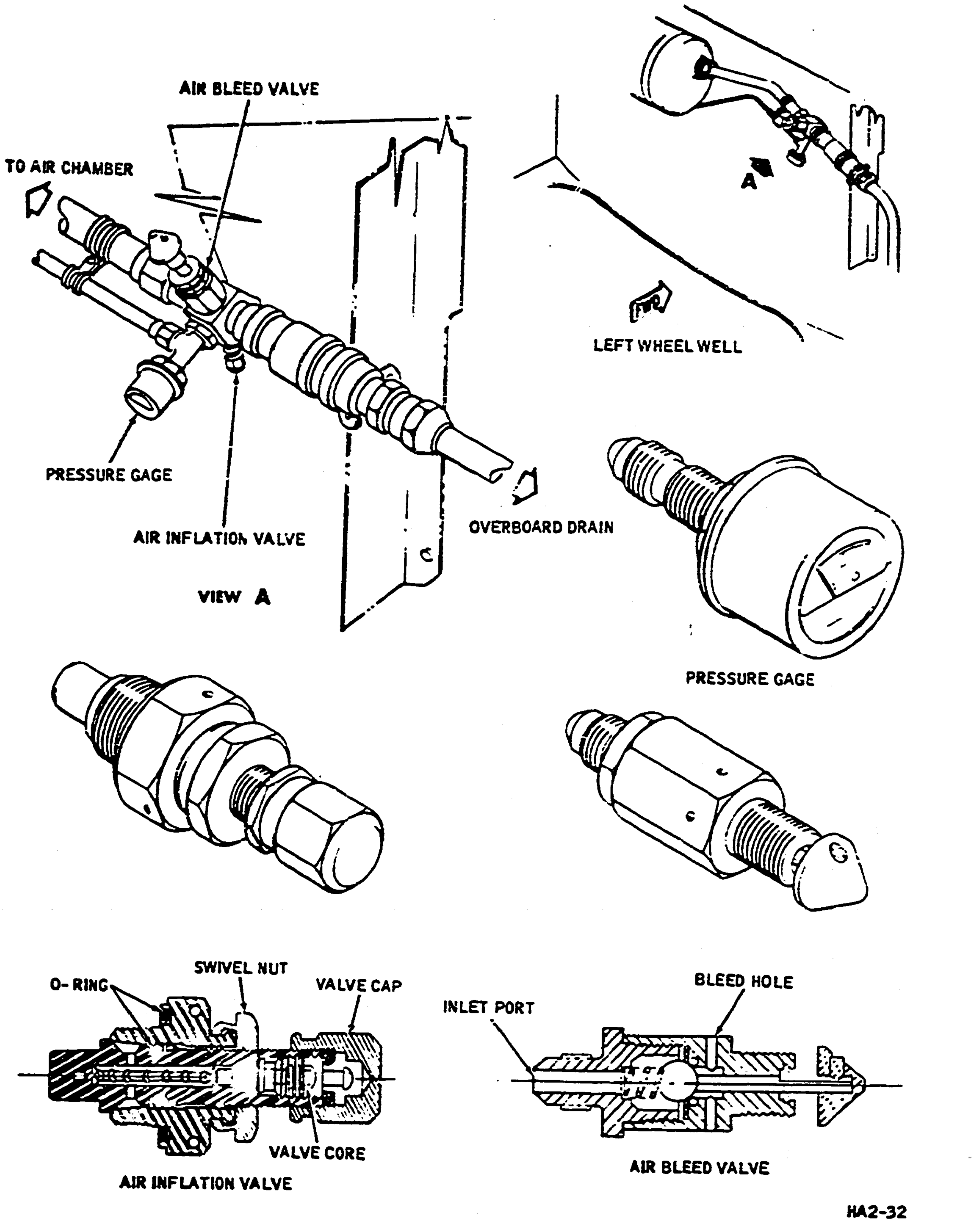
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

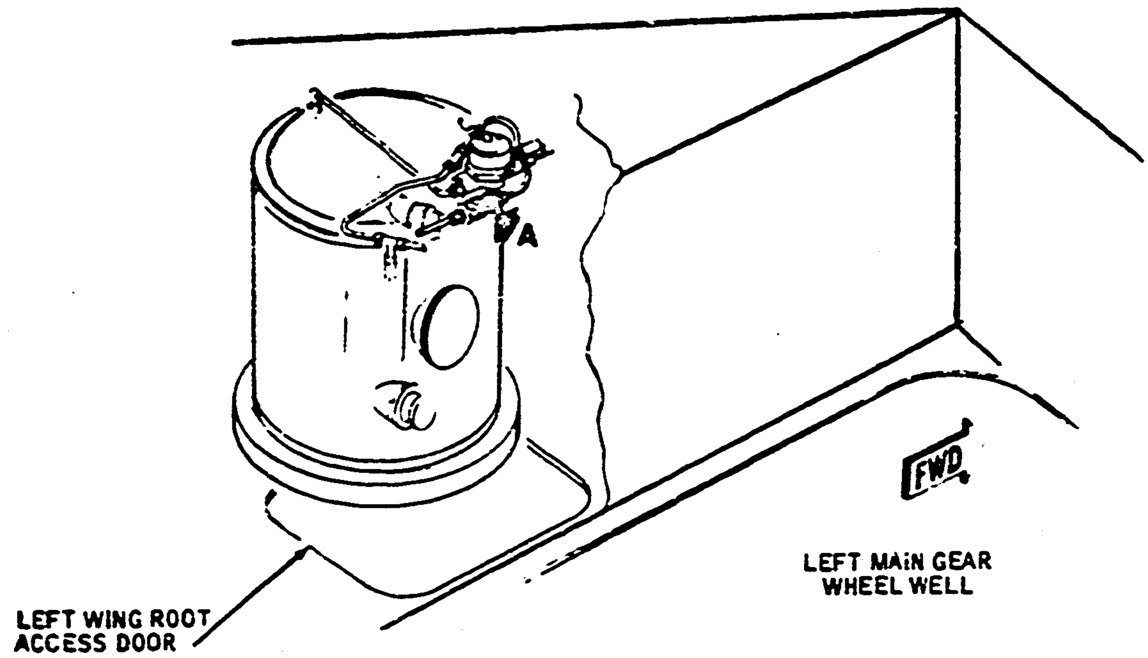
(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

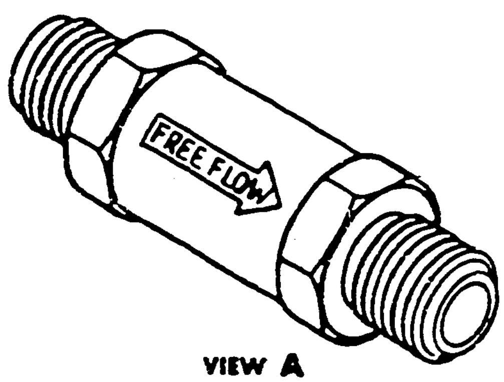
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

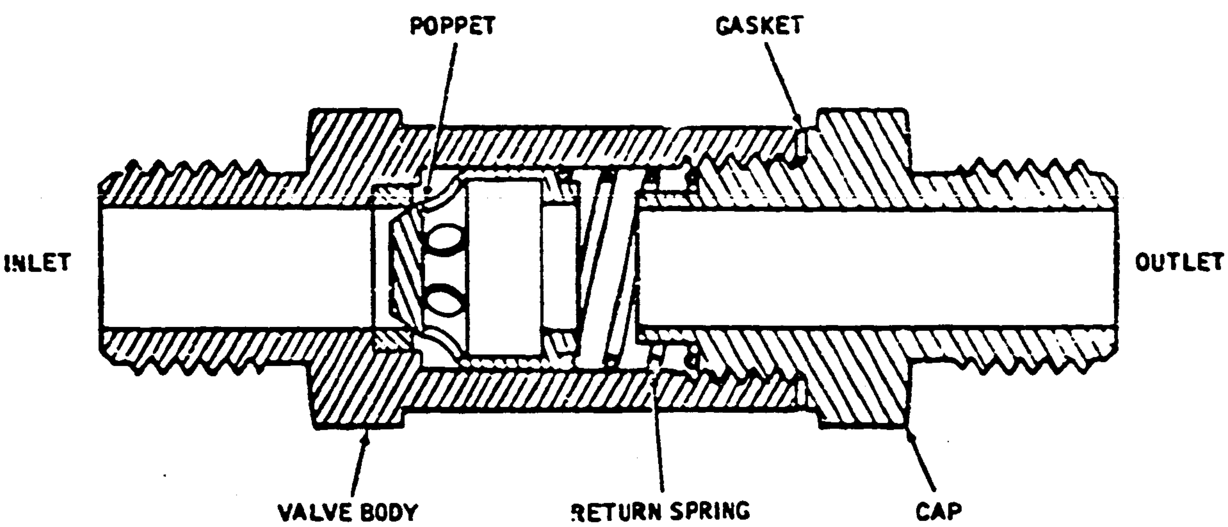


Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8





VIEW A



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Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

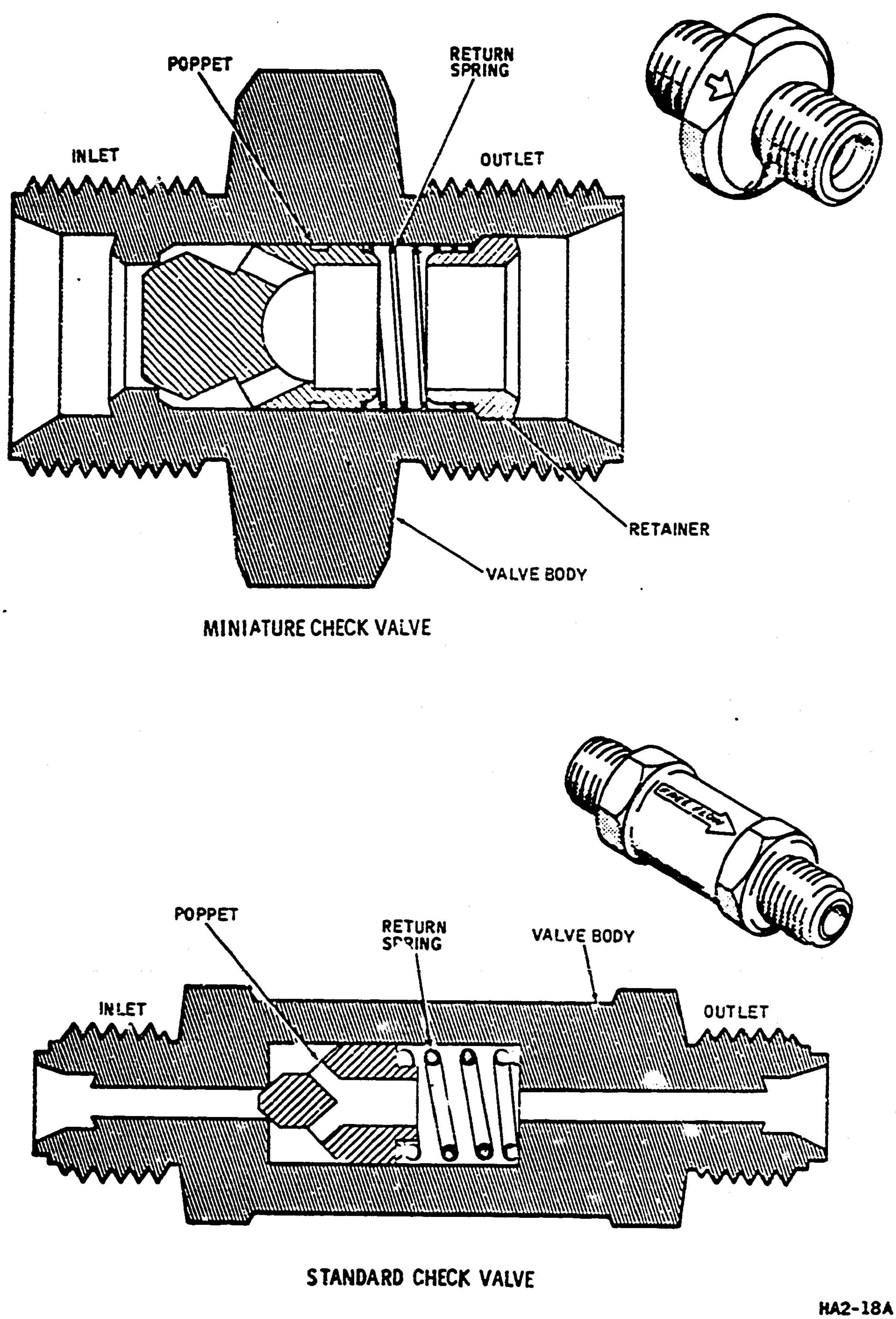
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

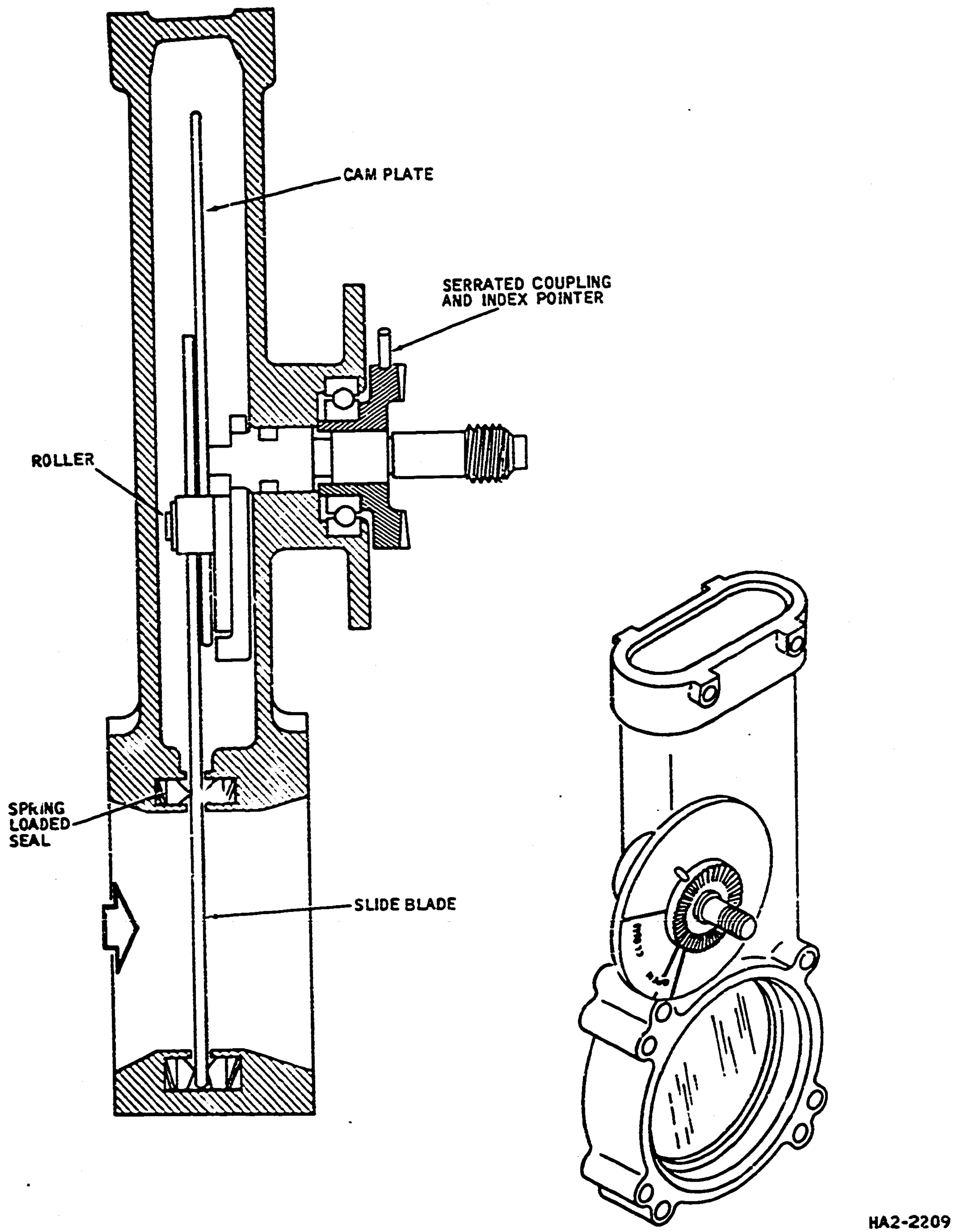
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

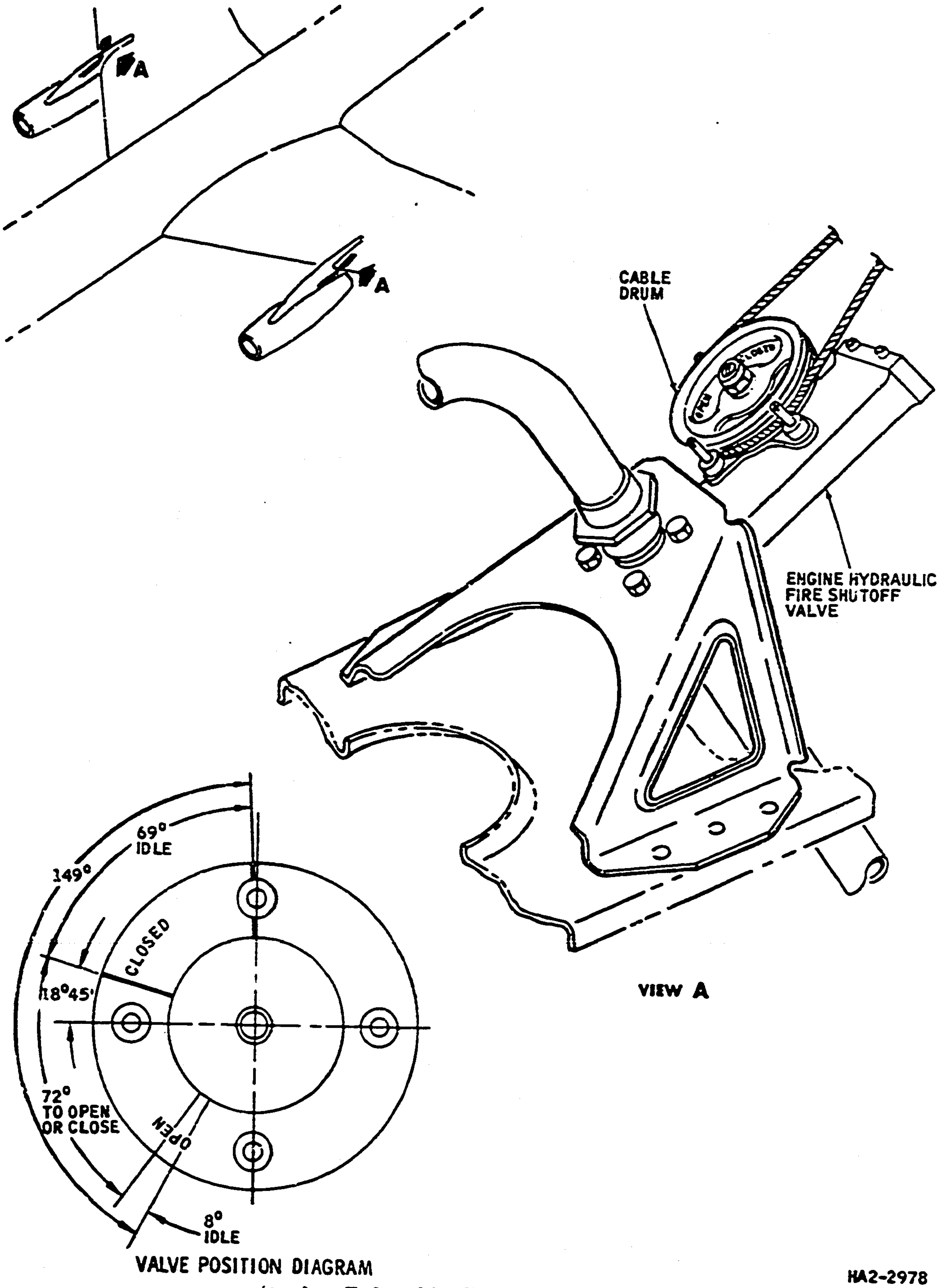
(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade



Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

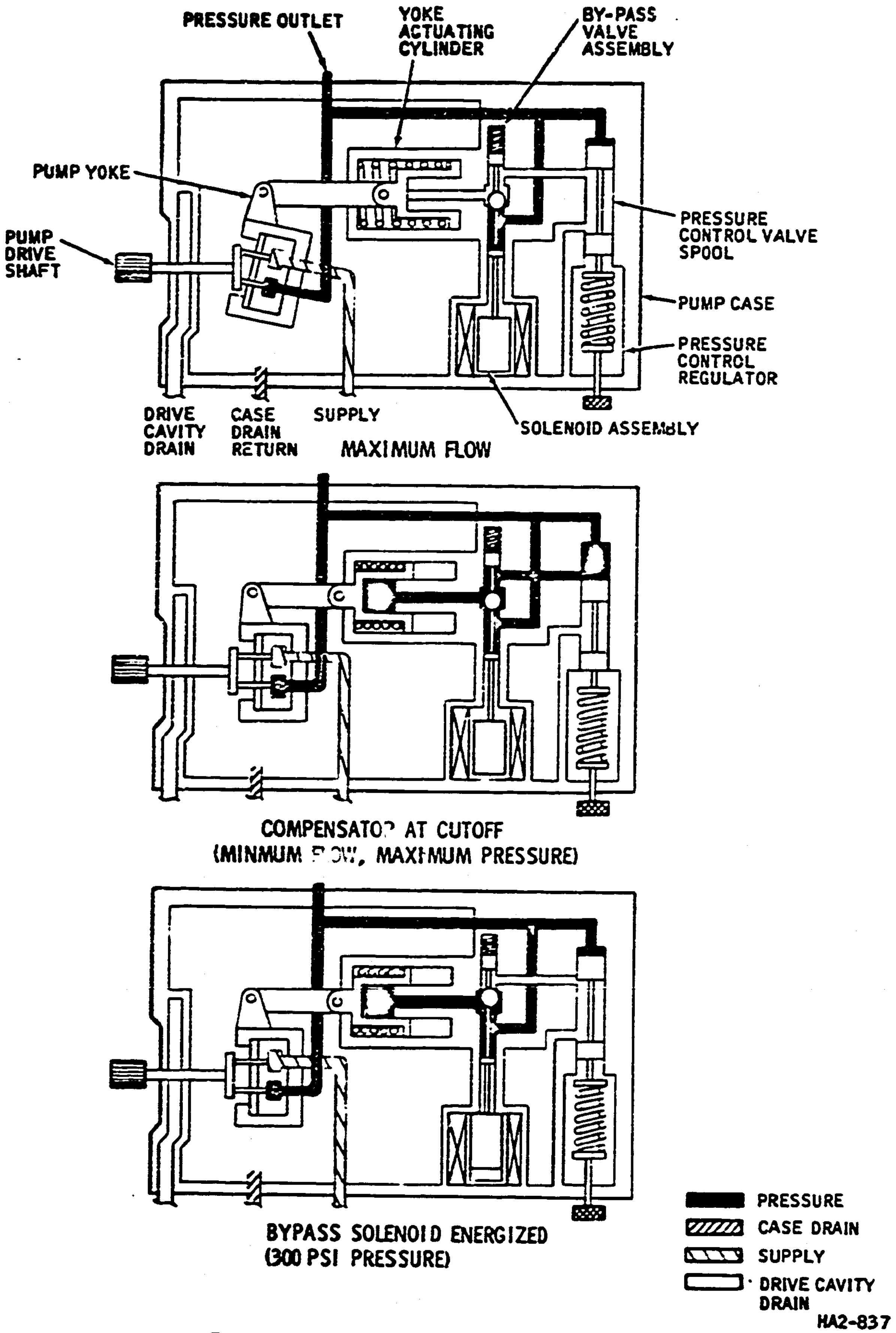
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (+100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing. On airplane 77, outlet port fitting contains a low-pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating driven shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. If the engine-driven hydraulic pump control switches are in the on position and the output pressure of either pump drops below 2000 psi on airplanes 55 through 58 and 1500 psi on 59 and subsequent, an amber light located in the flight compartment comes on.

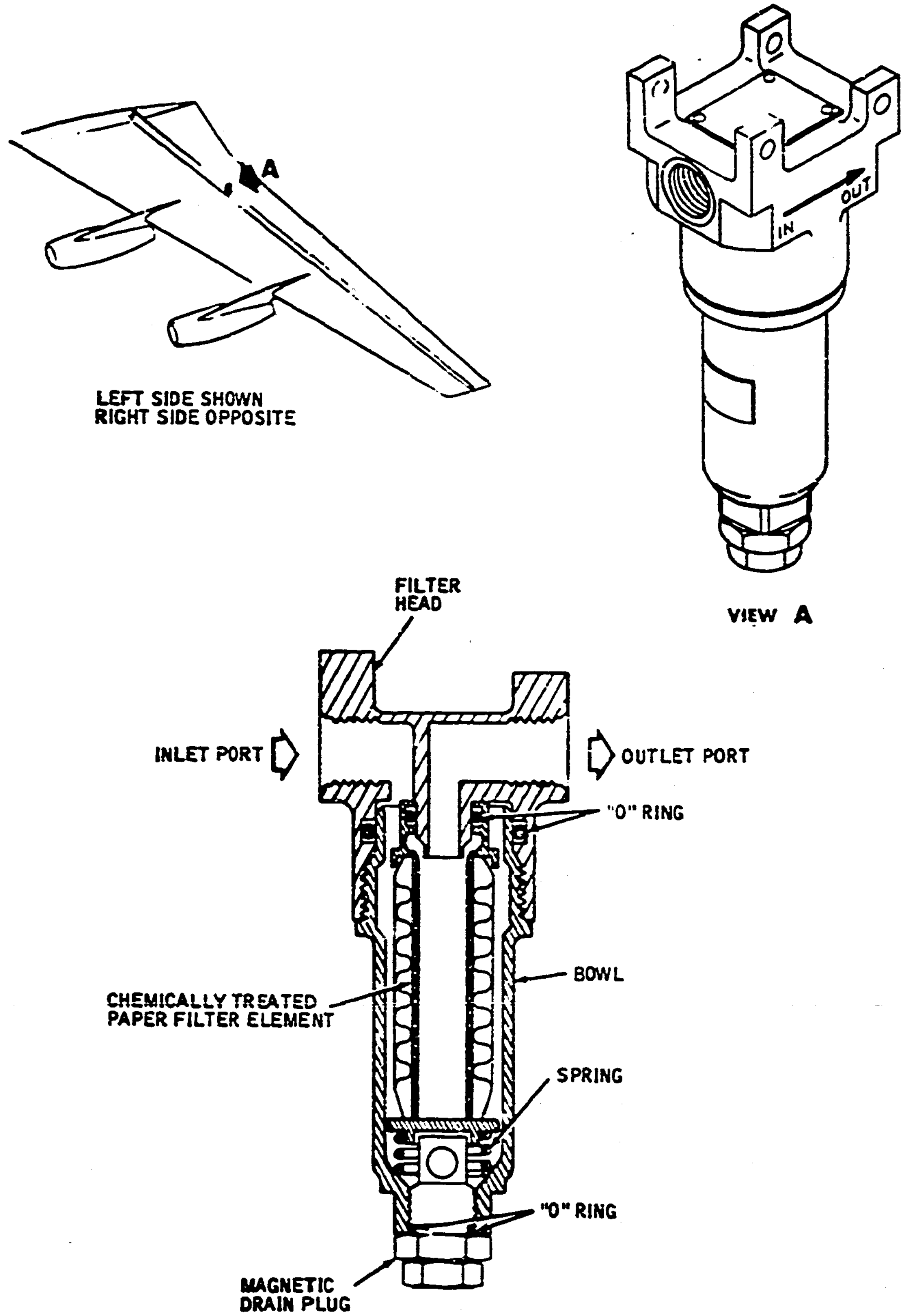
L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line



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Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

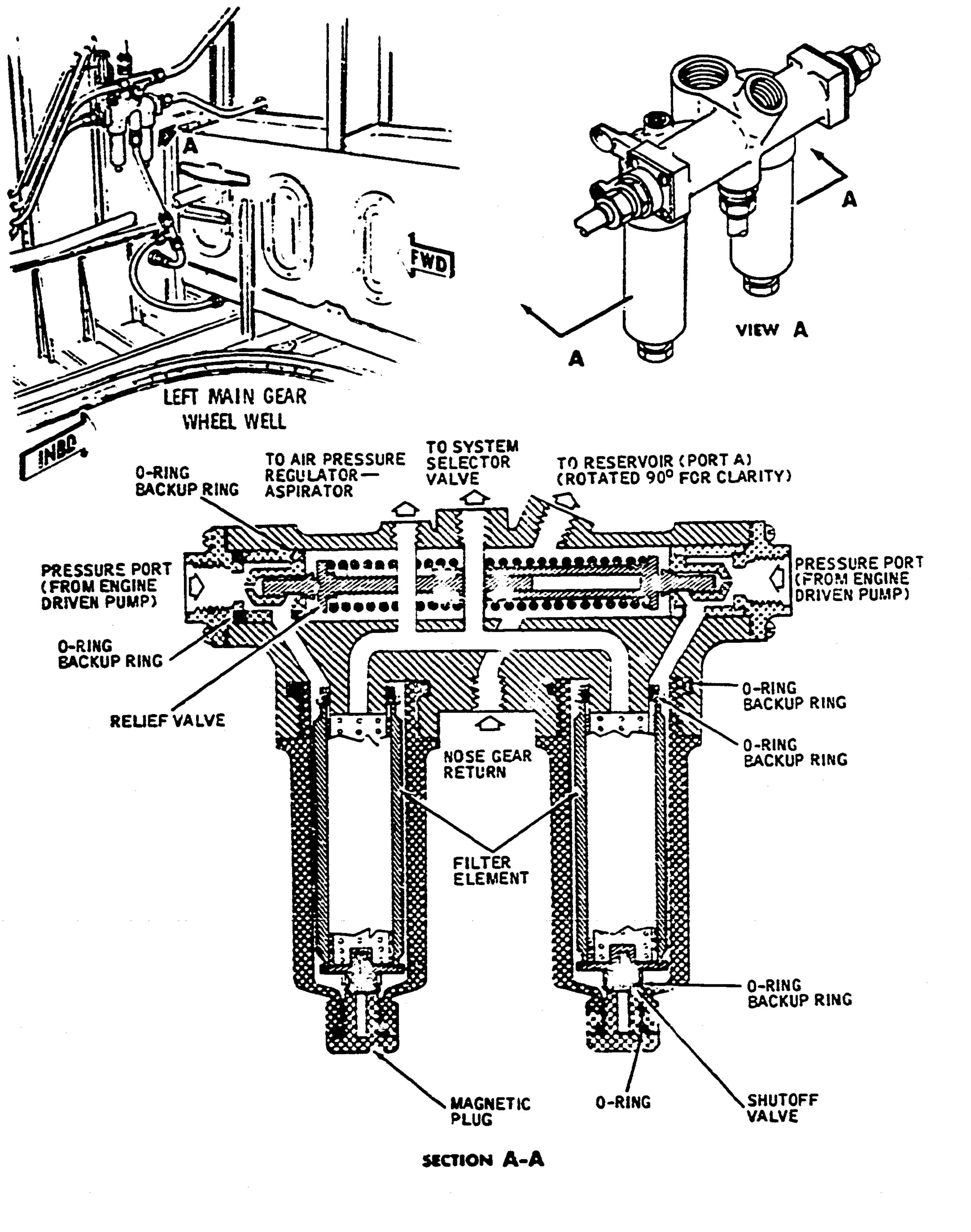
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



Dual-Filter and Relief Valve -- Cutaway Valve
Figure 15

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

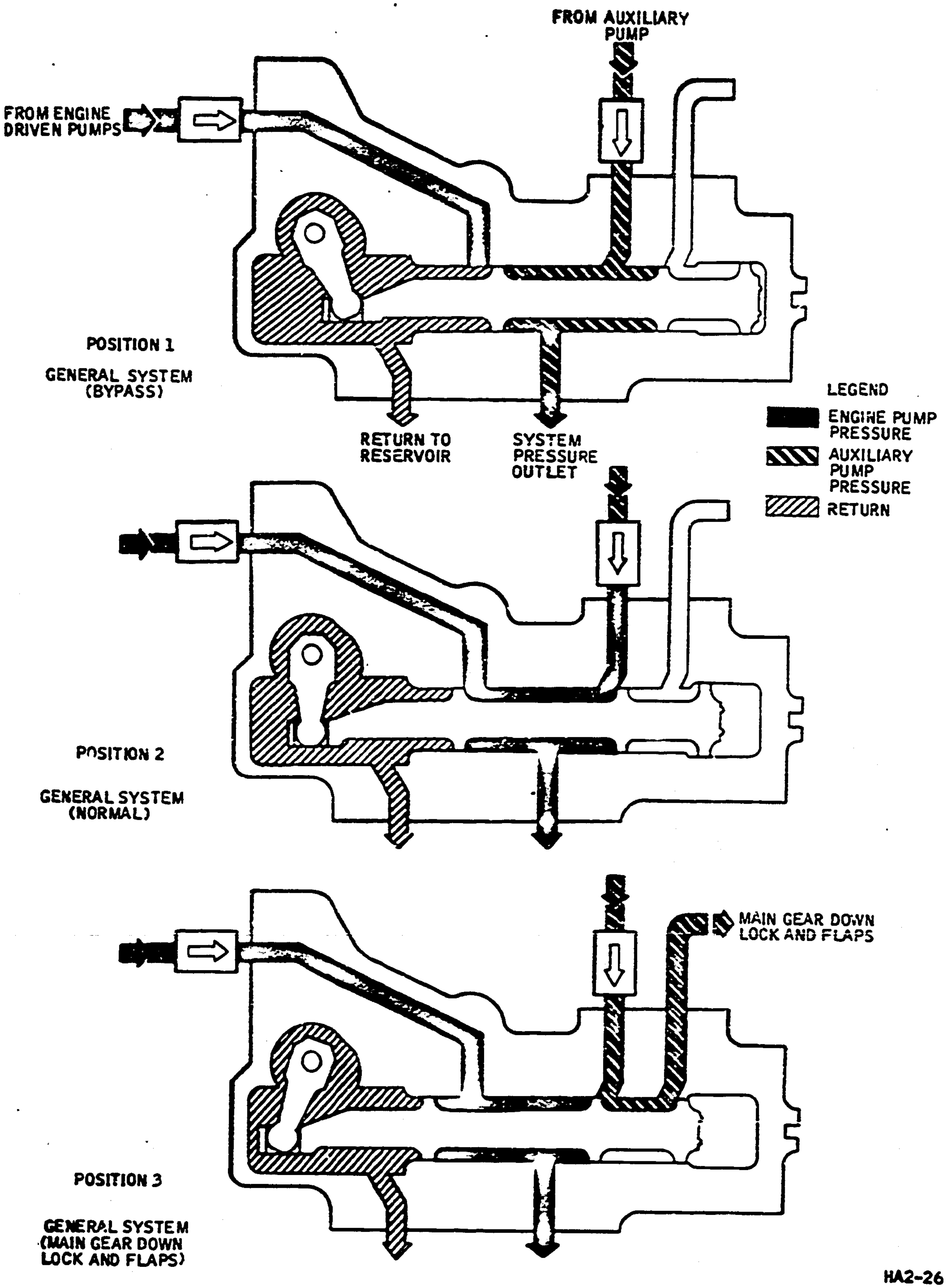
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

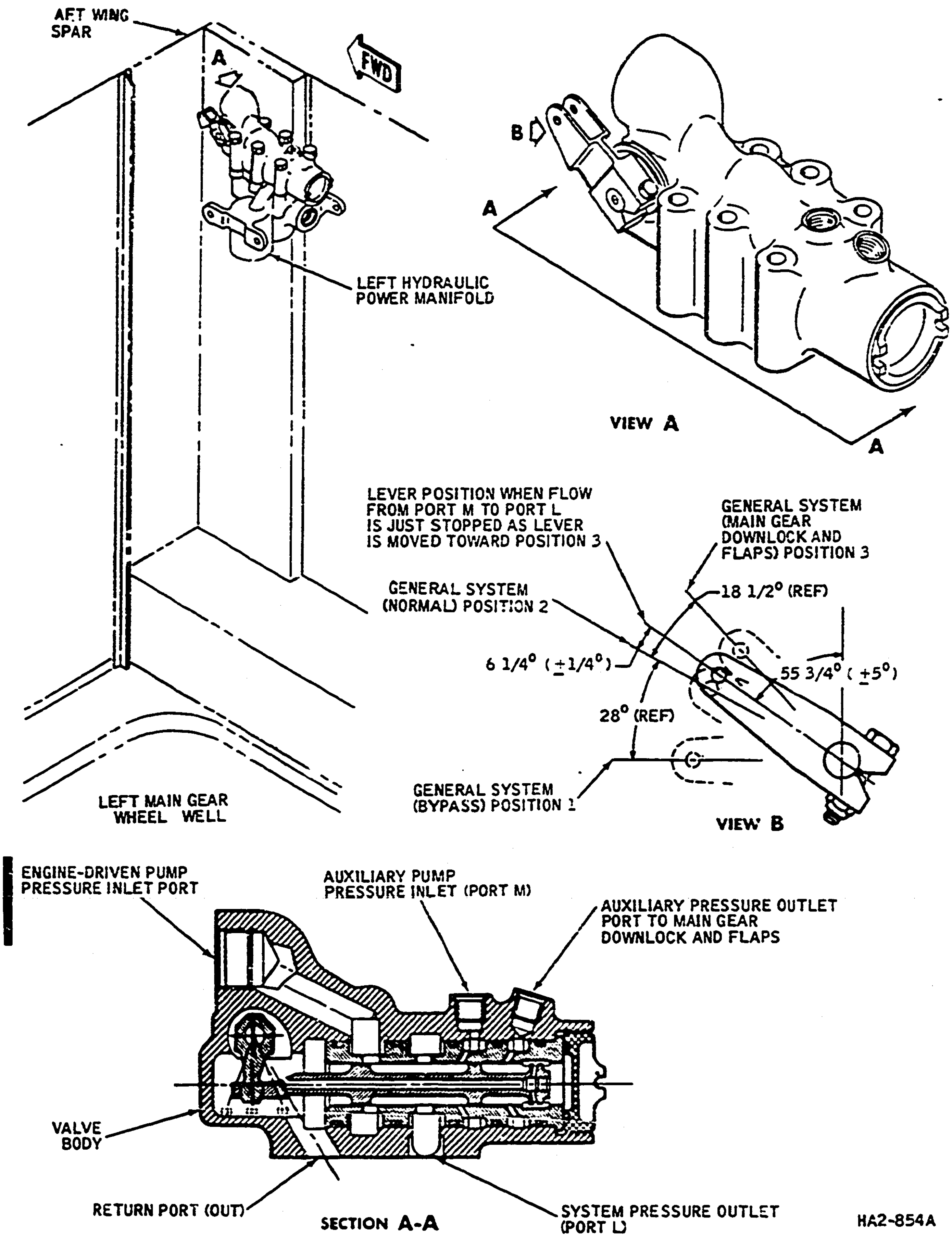
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

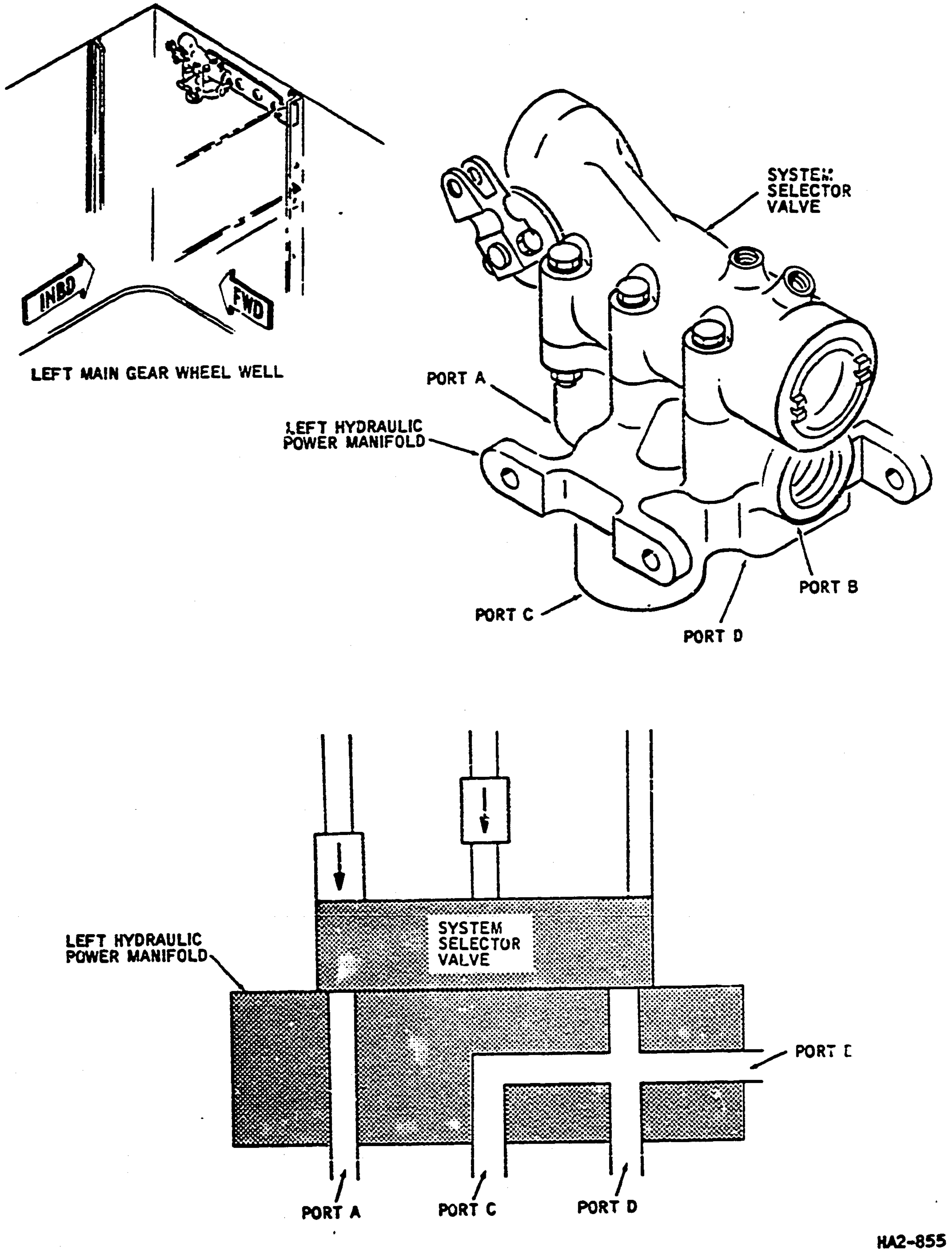
(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17



Left Hydraulic Power Manifold -- Schematic
Figure 18

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

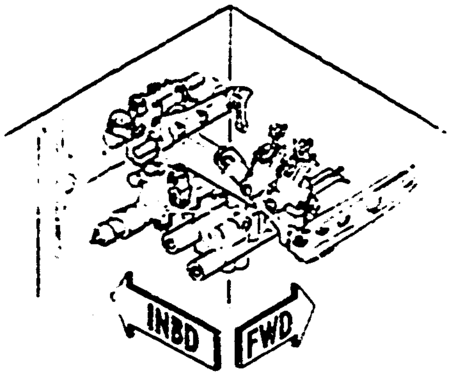
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

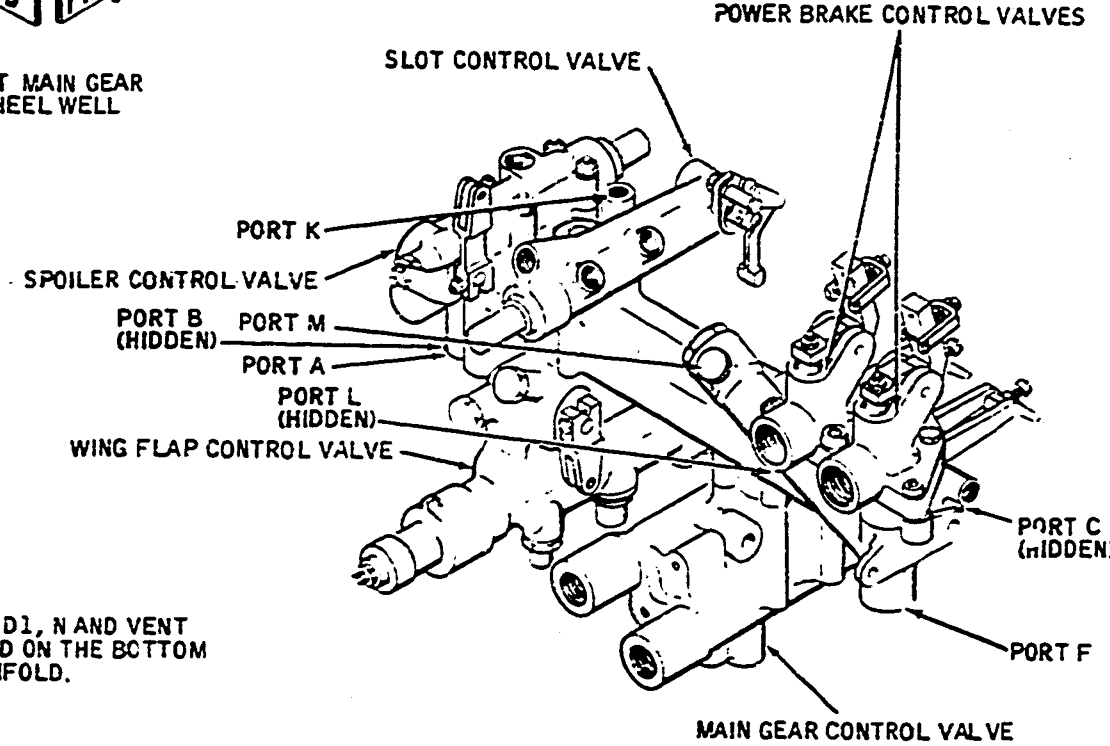
R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 20.)

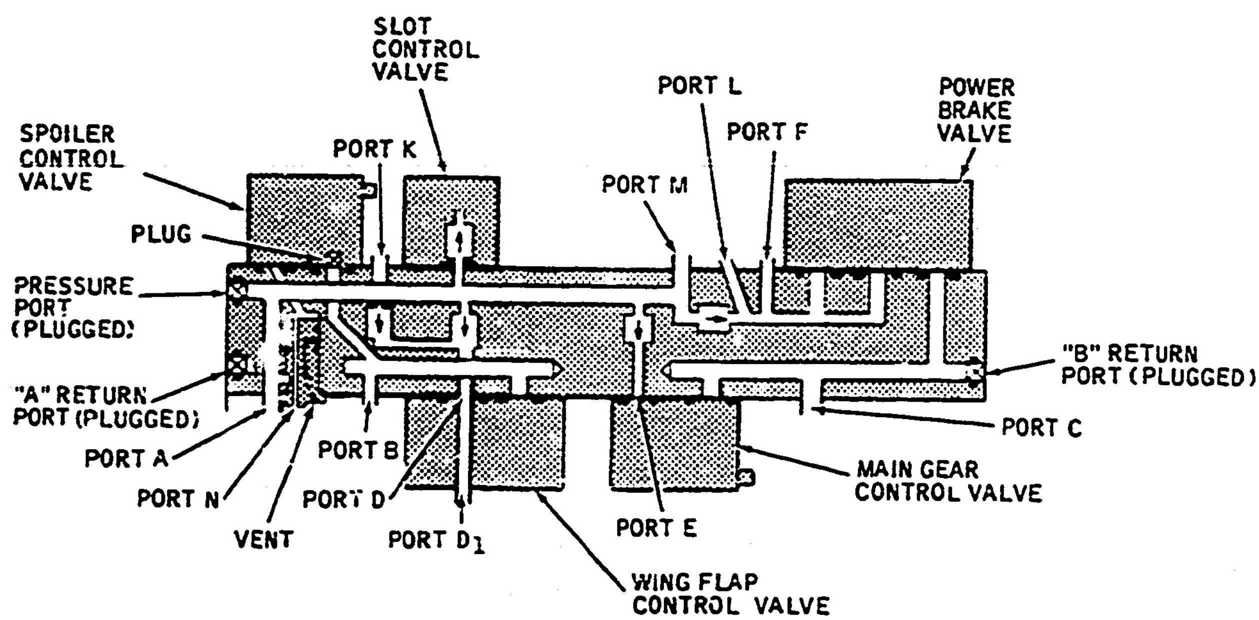
(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.



RIGHT MAIN GEAR WHEEL WELL



NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



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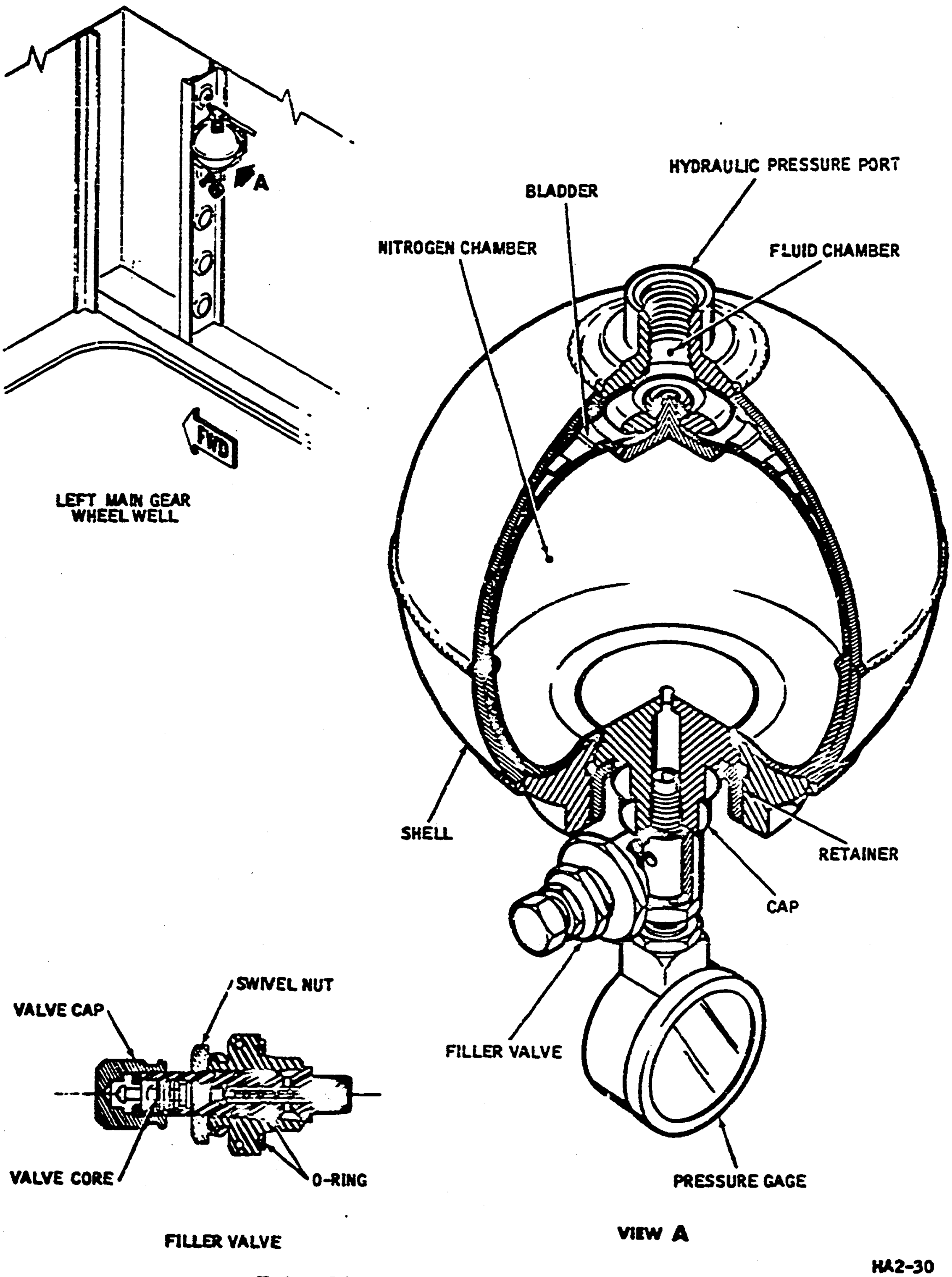
Right Hydraulic Power Manifold -- Schematic
Figure 19



Hydraulic Power System Accumulator --
Cutaway View
Figure 20

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

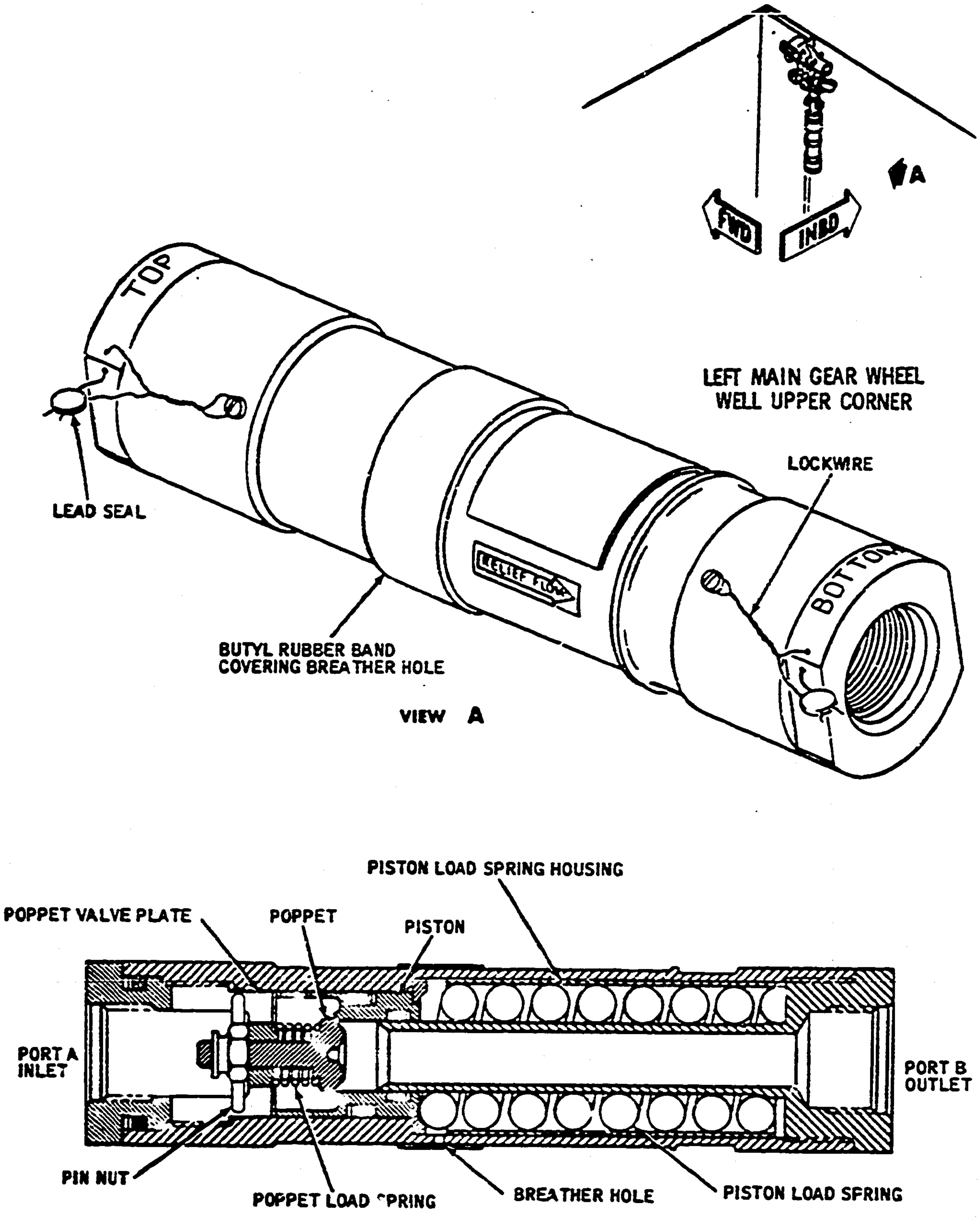
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smoothes out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.



Hydraulic System Priority Valve -- Cutaway View
Figure 21

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Manual Shutoff Valve

(1) On airplanes 55-75, 77, 78, two manually operated shutoff valves are provided just downstream of the priority valve for isolation of non-priority subsystems during maintenance operations. One valve shuts off pressure to the following subsystems:

(a) Wing flaps

(b) Wing slots

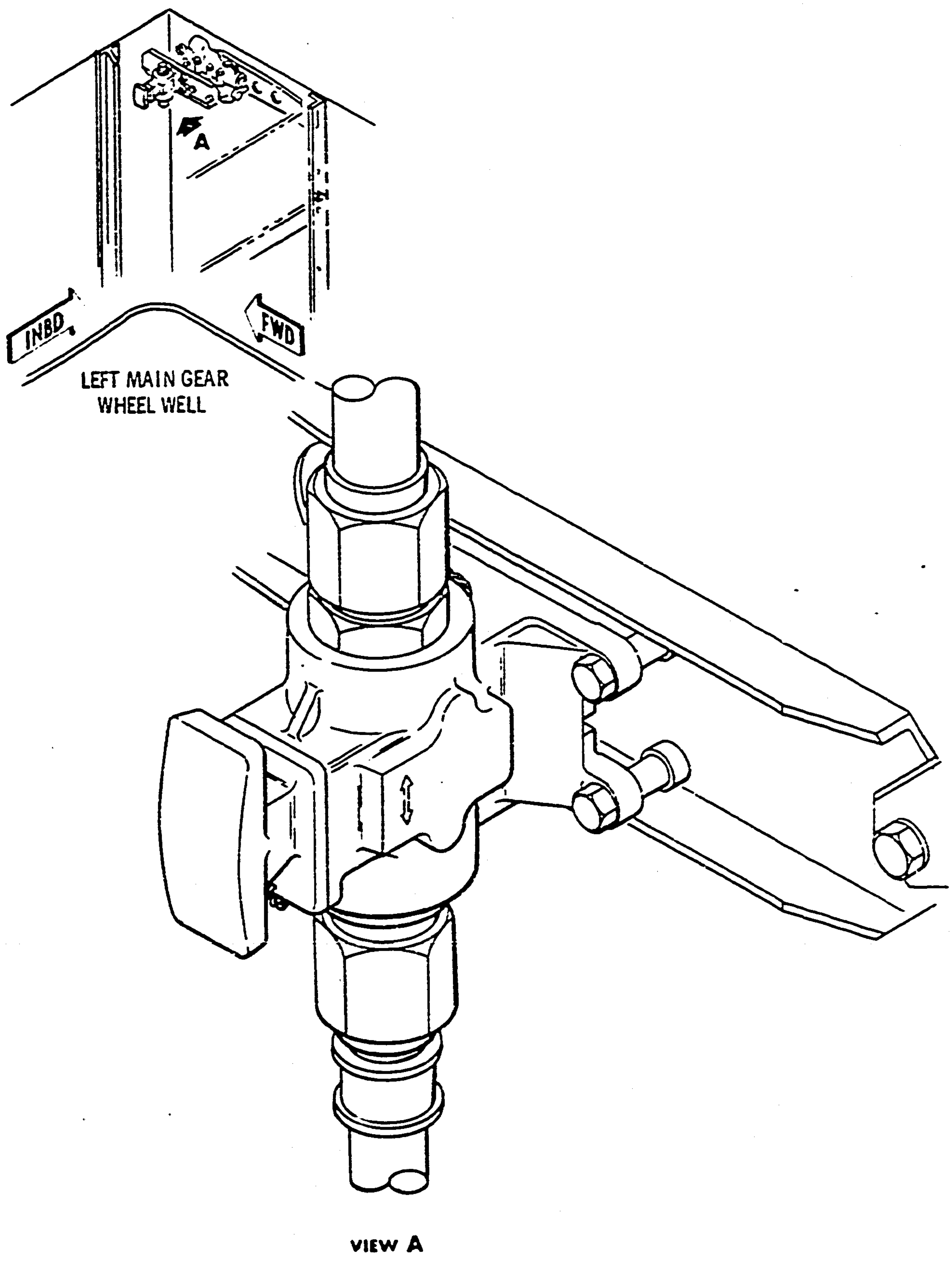
(c) Main landing gear retraction

(d) Power wheel brakes

(2) The other valve shuts off pressure to the nosegear retraction and nosewheel steering subsystems.

(3) The manual shutoff valves are located in the upper inboard forward corner of the left main gear wheel well. One valve is mounted on the left power manifold support, the other is mounted to a structure stiffener.

(4) The valves consist of two position (on-off), rotary type, valves with identical and interchangeable inlet and outlet ports. A T shaped handle is provided on each valve for manual operation and lockwire holes are



Manual Shutoff Valve
(Airplanes 55-75, 77, 78)
Figure 22

provided in the base of the handle for safetying the valve in the open position.

V. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

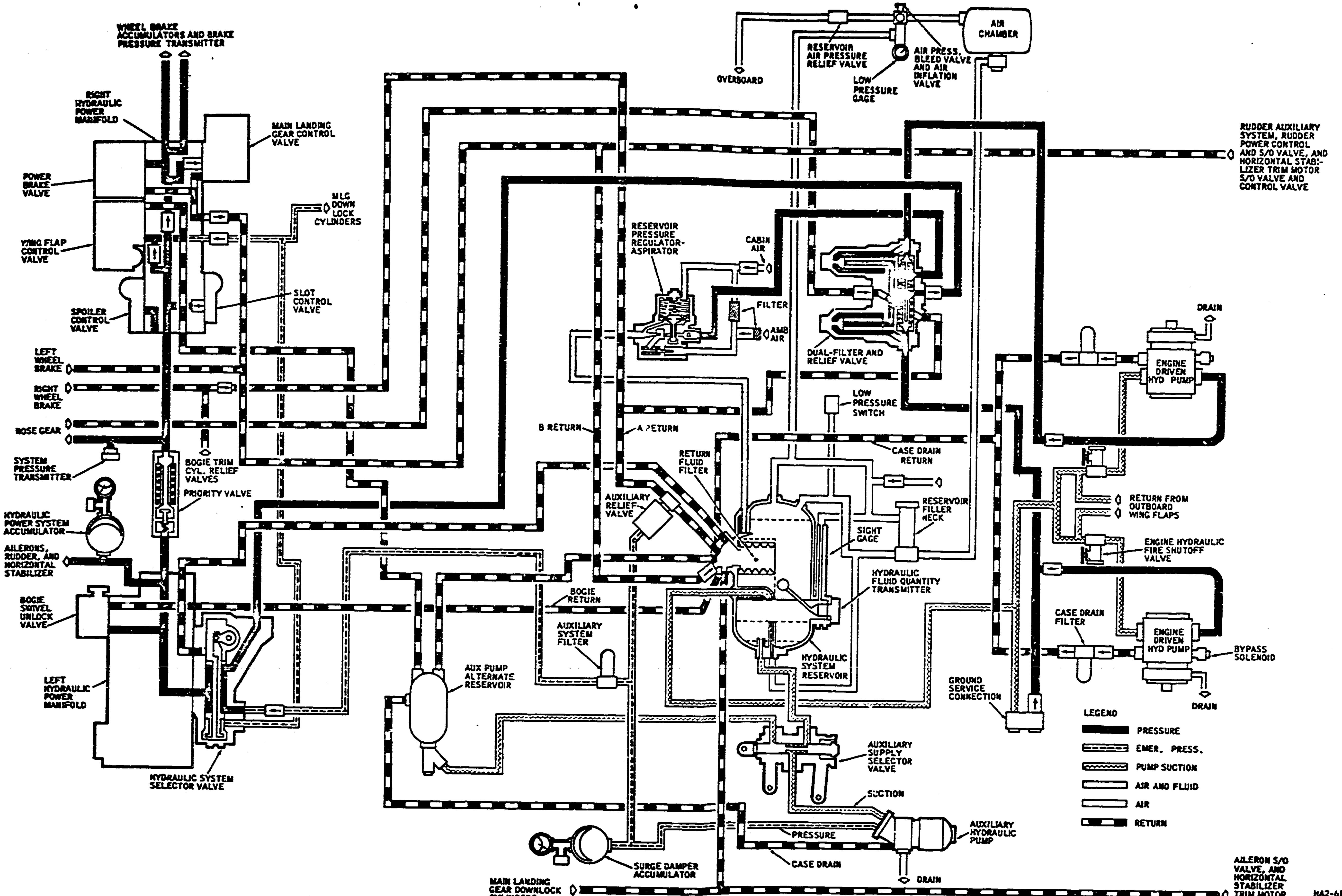
(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

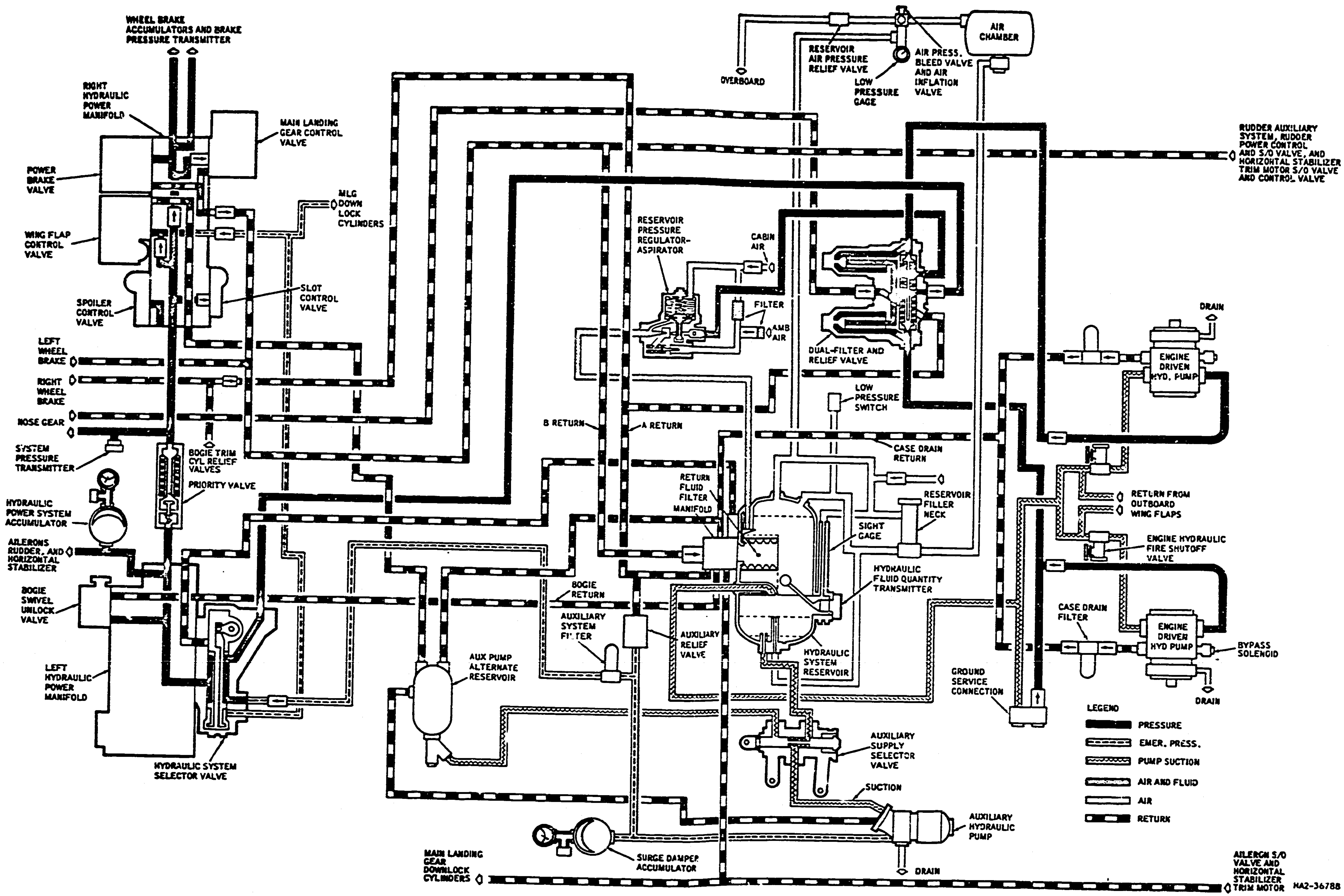
B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.



Hydraulic Power System -- Schematic Diagram
(Airplane N45090)
Figure 1 (Sheet 1)



Hydraulic Power System -- Schematic Diagram
(Airplane N45191)
Figure 1 (Sheet 2)

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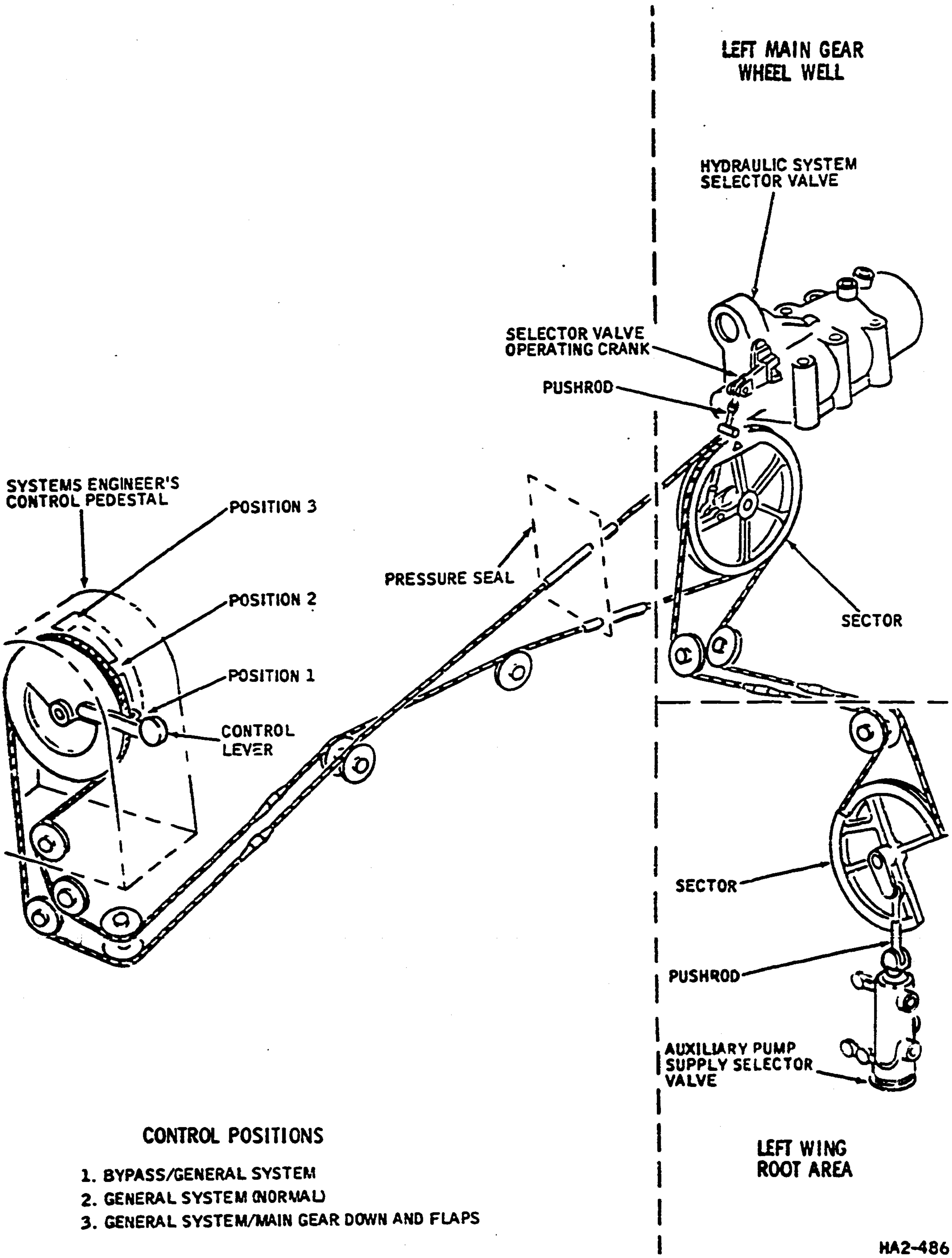


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this po. :lows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the

auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

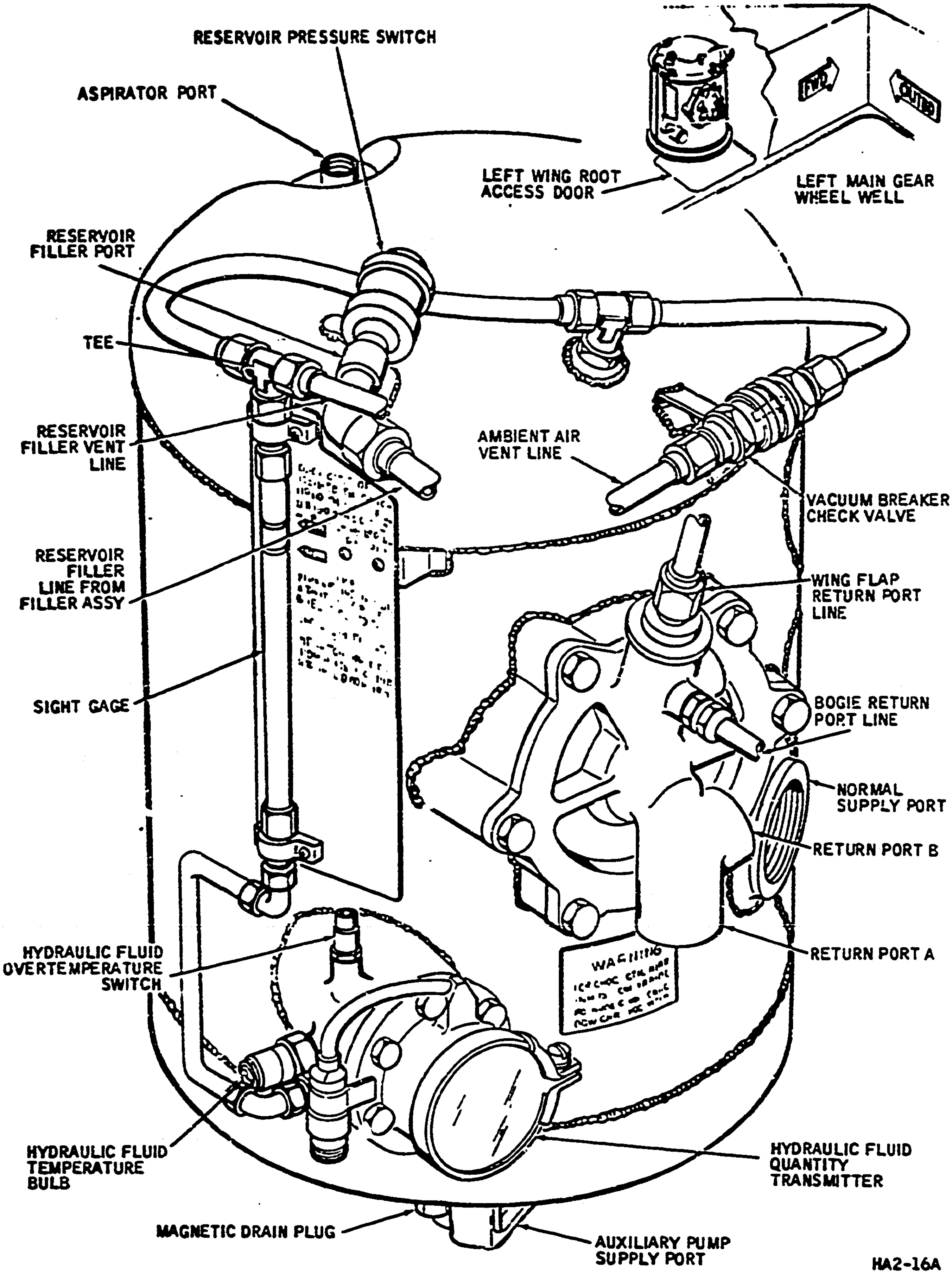
(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

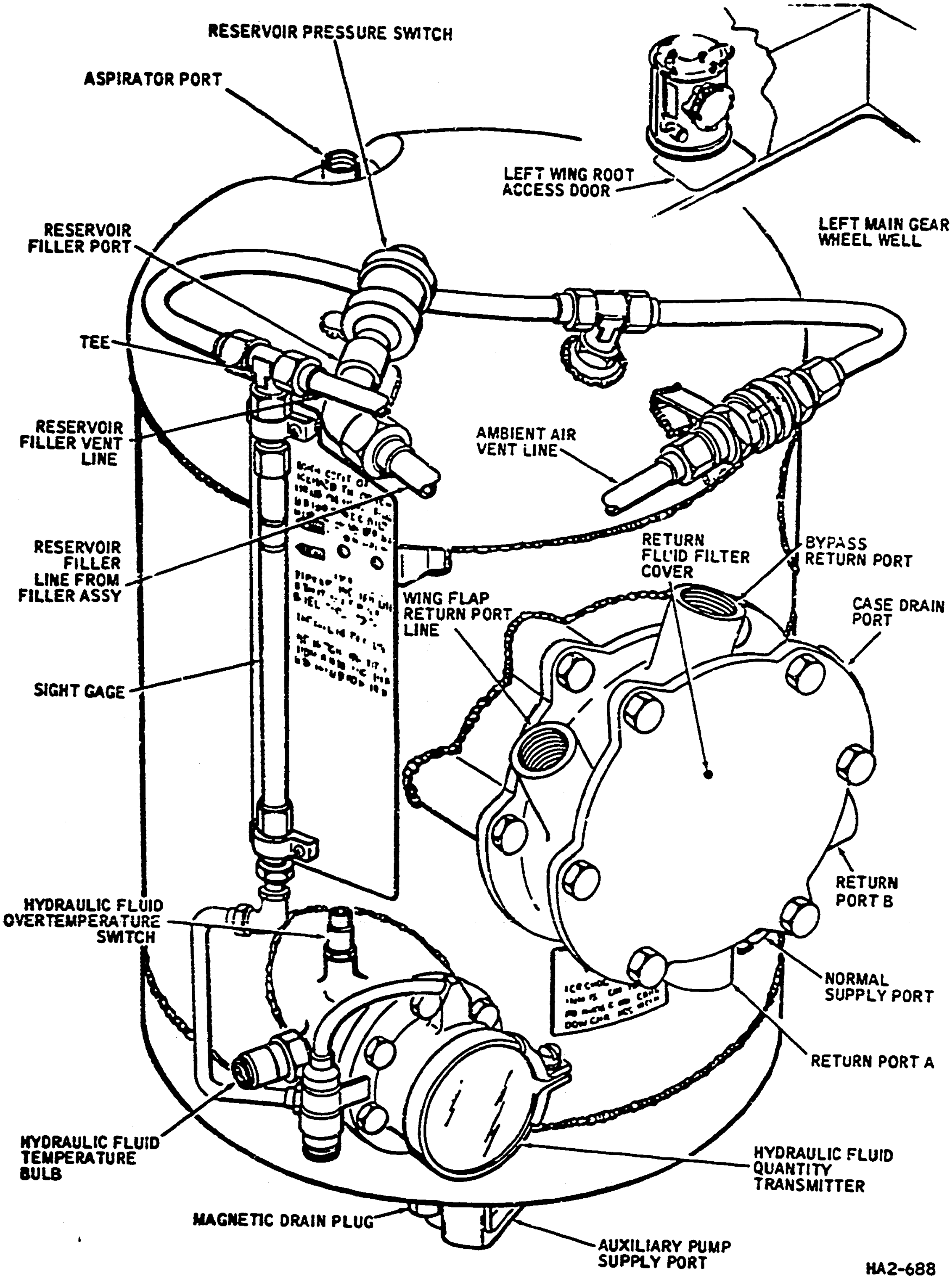
(4) On airplane N45090 the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The manifold is bolted to the flange and contains five ports: return port A, located at the bottom; return port B, located at the lower right side; the low-pressure return port, located at the upper right; the wing flap return port, located at the top; and the bogie return port, located on the face of the manifold just below the wing flap return port.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the manifold holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) On airplanes N45191 and subsequent, the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right



Hydraulic System Reservoir -- External View
(Airplane N45090)
Figure 3 (Sheet 1)



Hydraulic System Reservoir — External View
(Airplanes N45191 and Subsequent)
Figure 3 (Sheet 2)

side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(7) The return fluid filter is installed in the reservoir behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

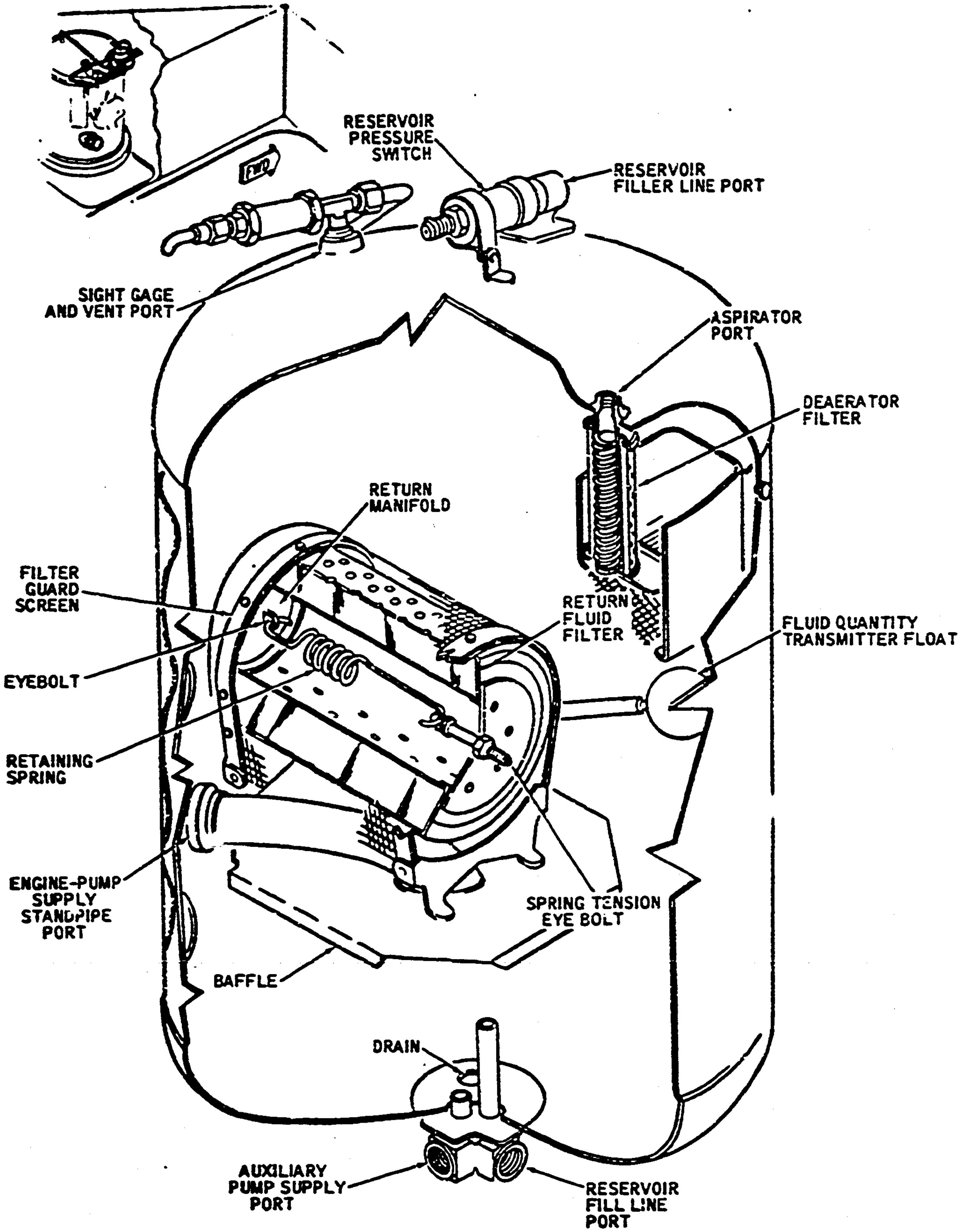
(8) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold and is spring loaded to act as its own relief valve. On airplane N45090 access to the filter is by removing the return ports manifold. Removal of the return ports manifold necessitates disconnecting the return lines from the manifold and removal of six bolts which secure the manifold to the reservoir. The filter which is attached to the manifold is then withdrawn from the reservoir. On airplanes N45191 and subsequent access to the filter is gained by removing the return filter cover from the return ports manifold by removal of six bolts. The filter is attached to the cover by a retaining spring, and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside

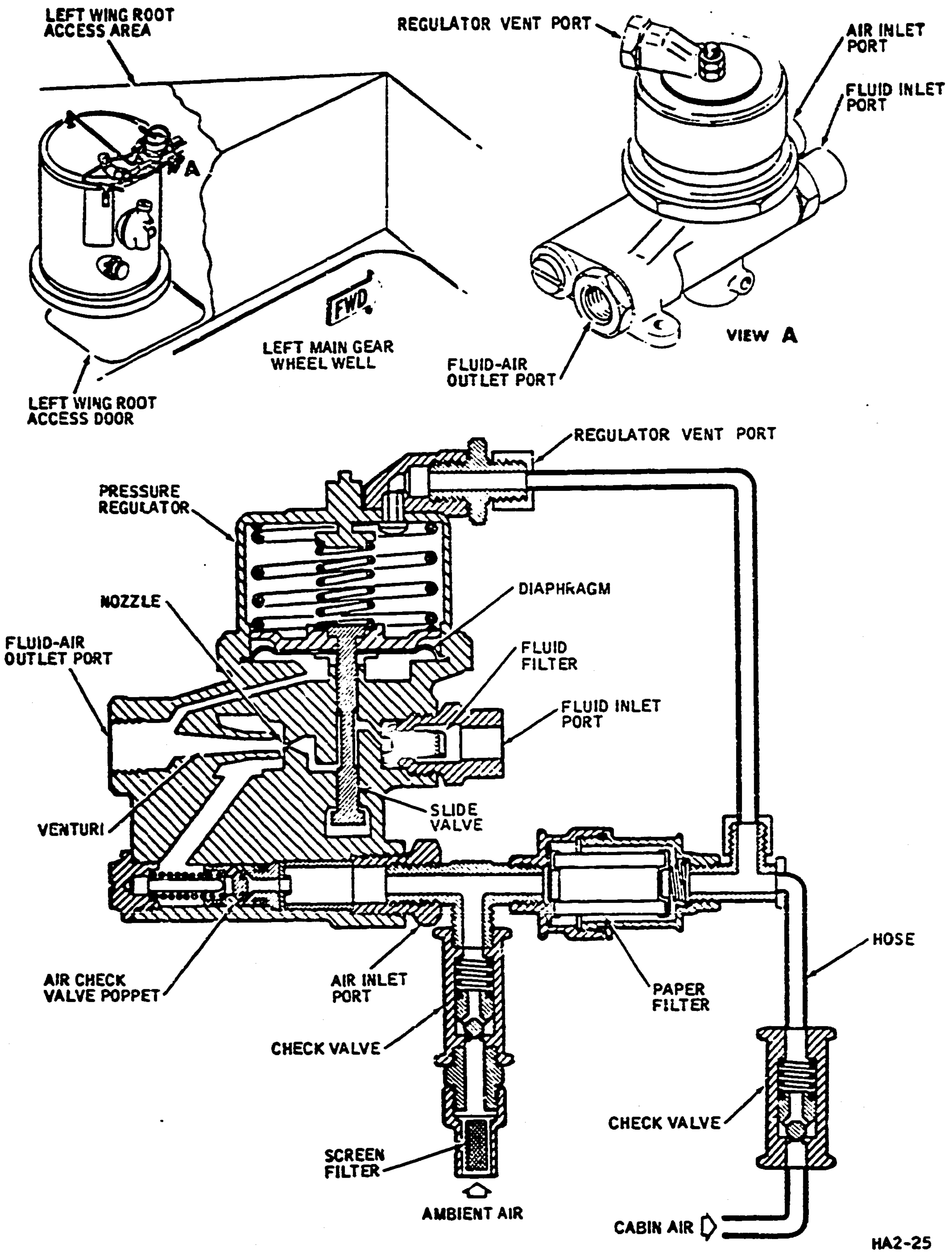


Hydraulic System Reservoir -- Cutaway View
Figure 4

the return port's manifold. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

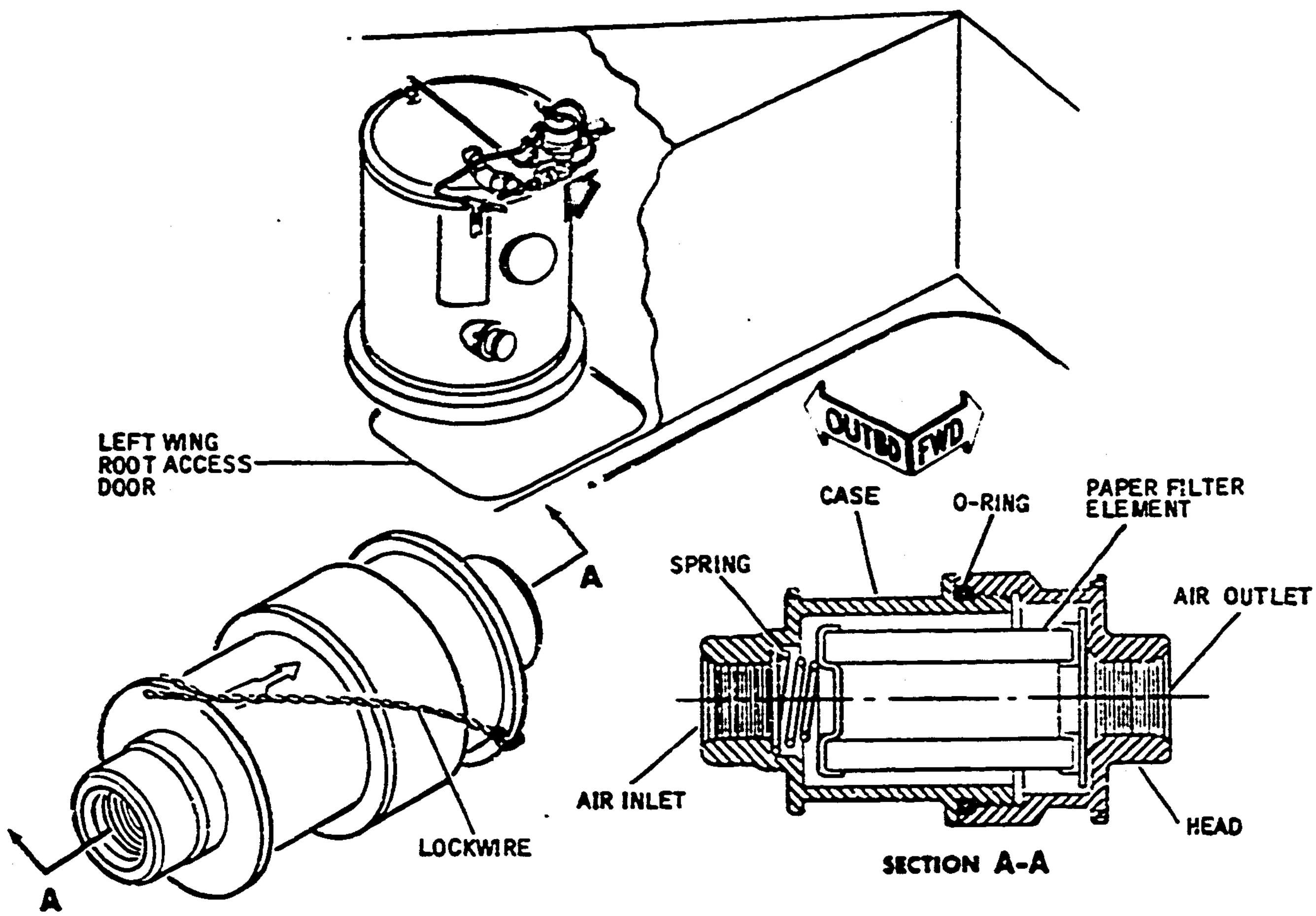
(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.



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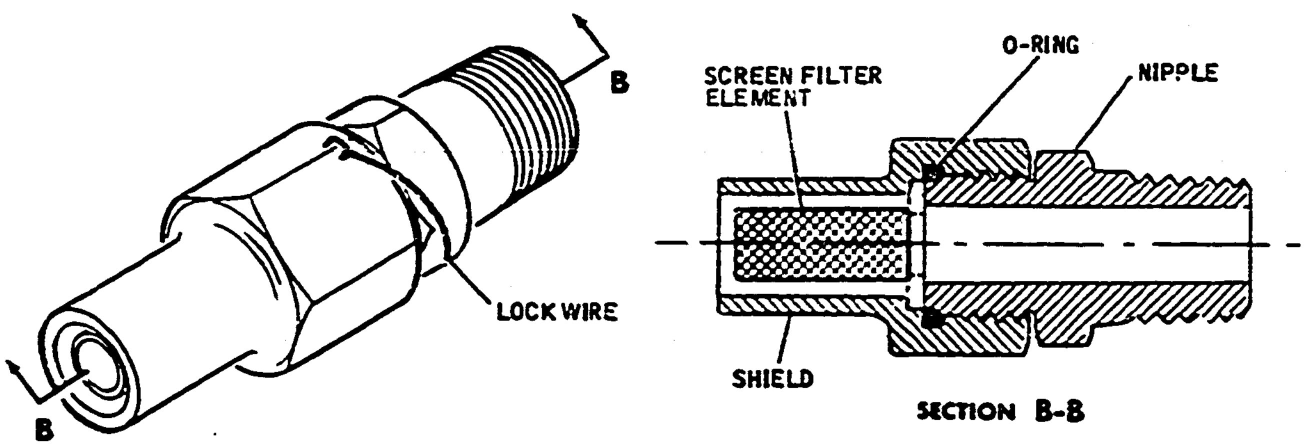
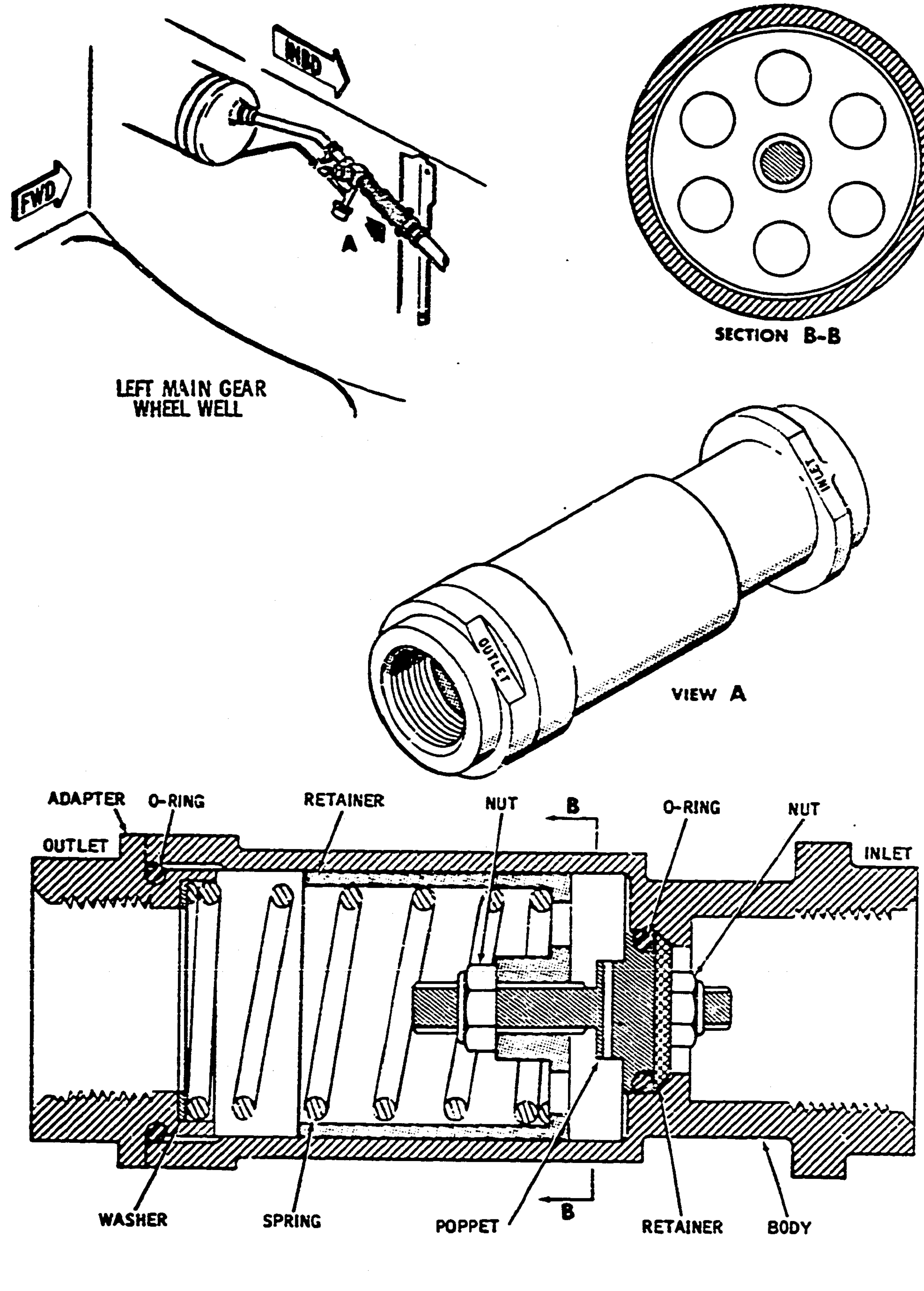


SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



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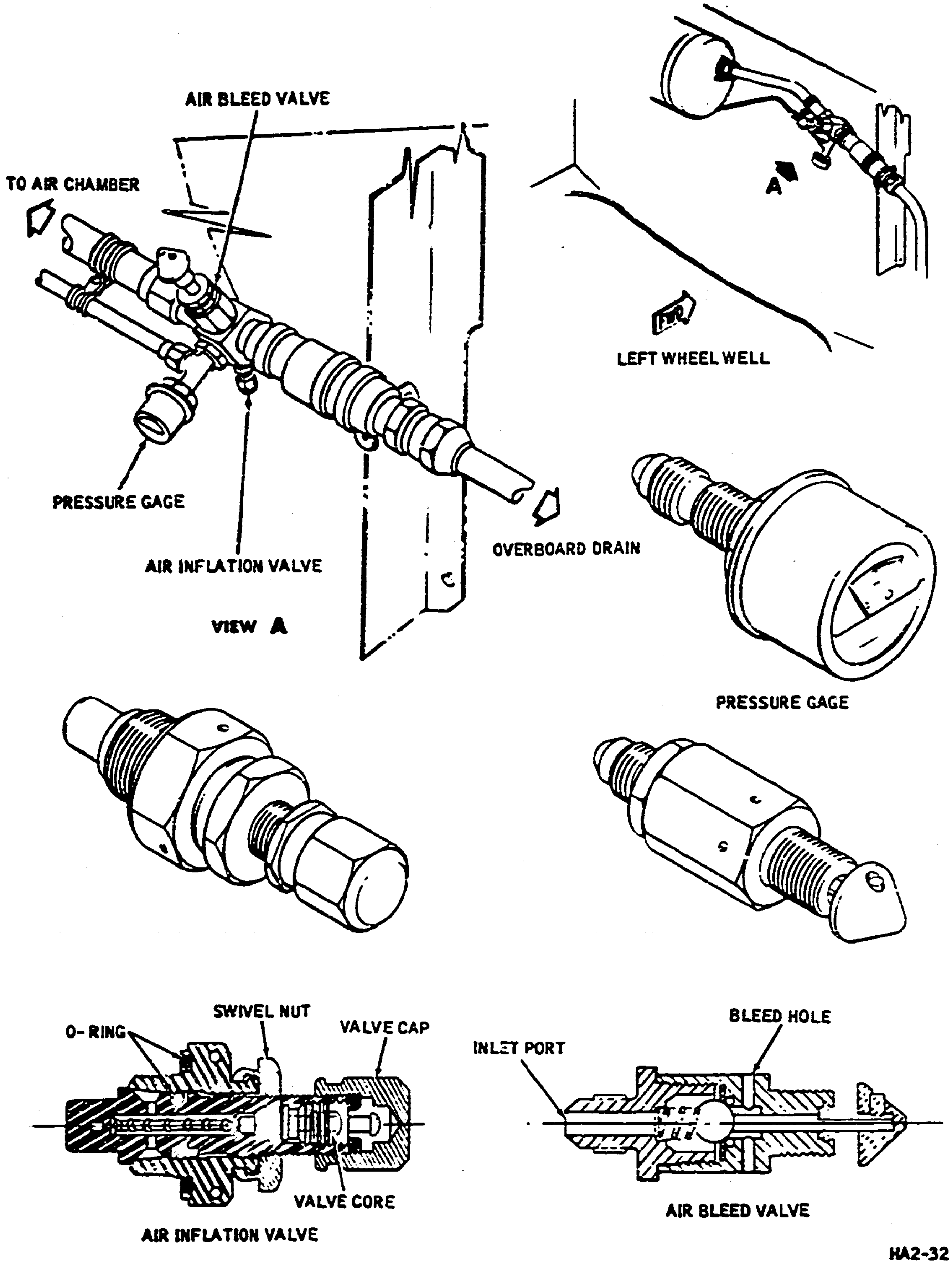
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

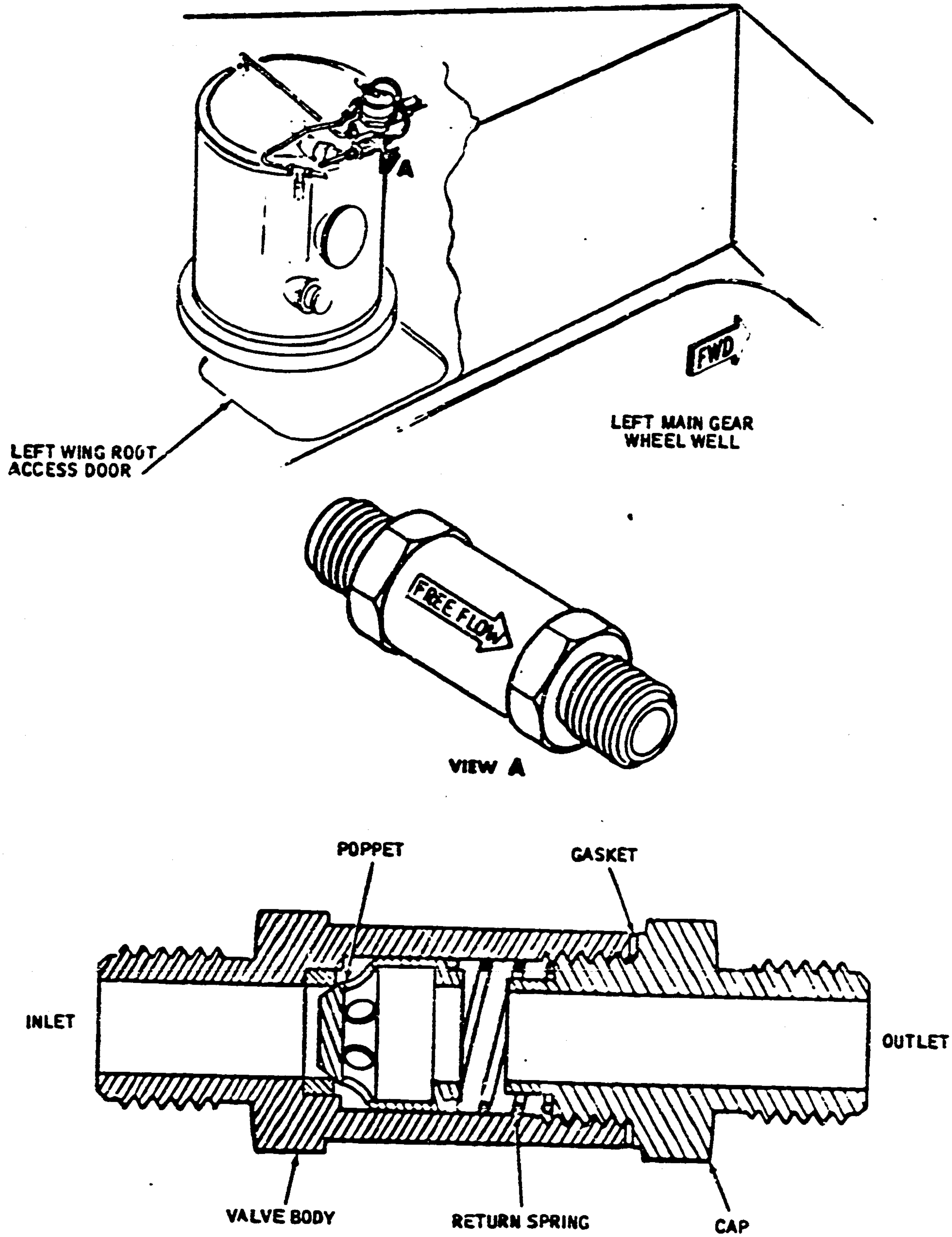
I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

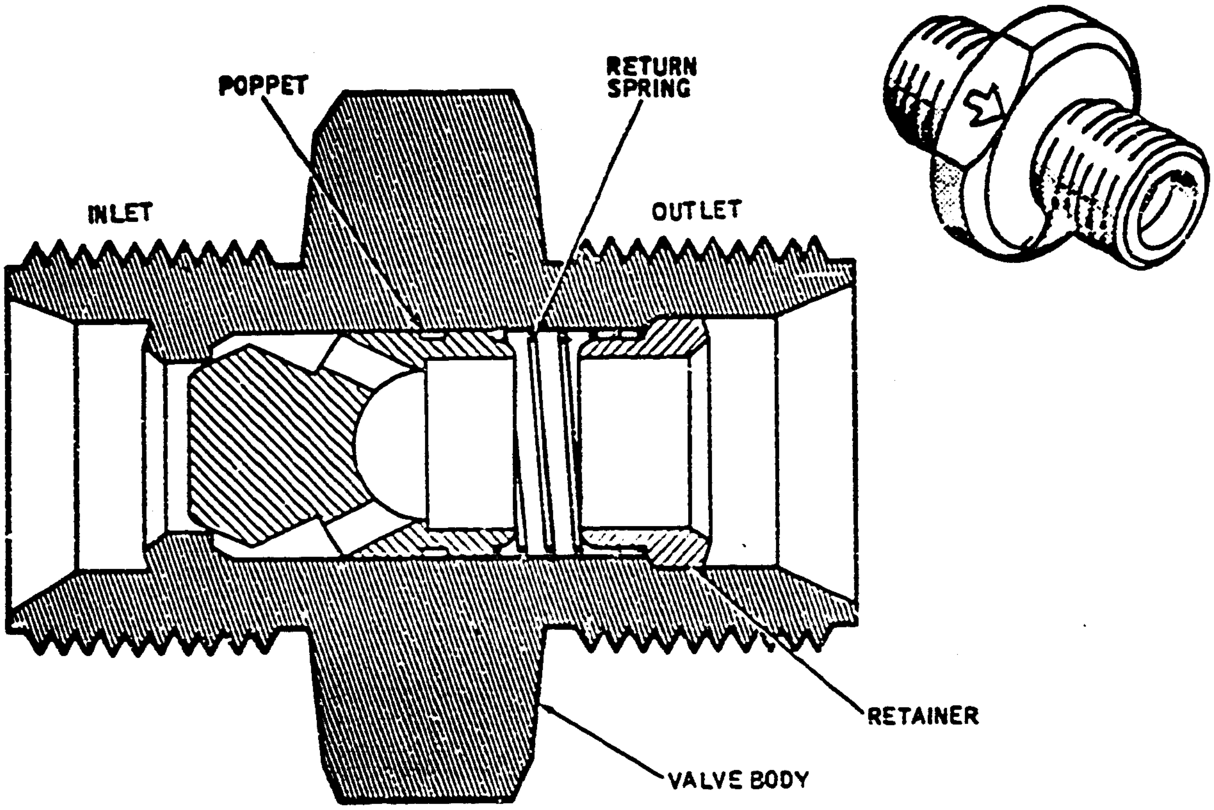
J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

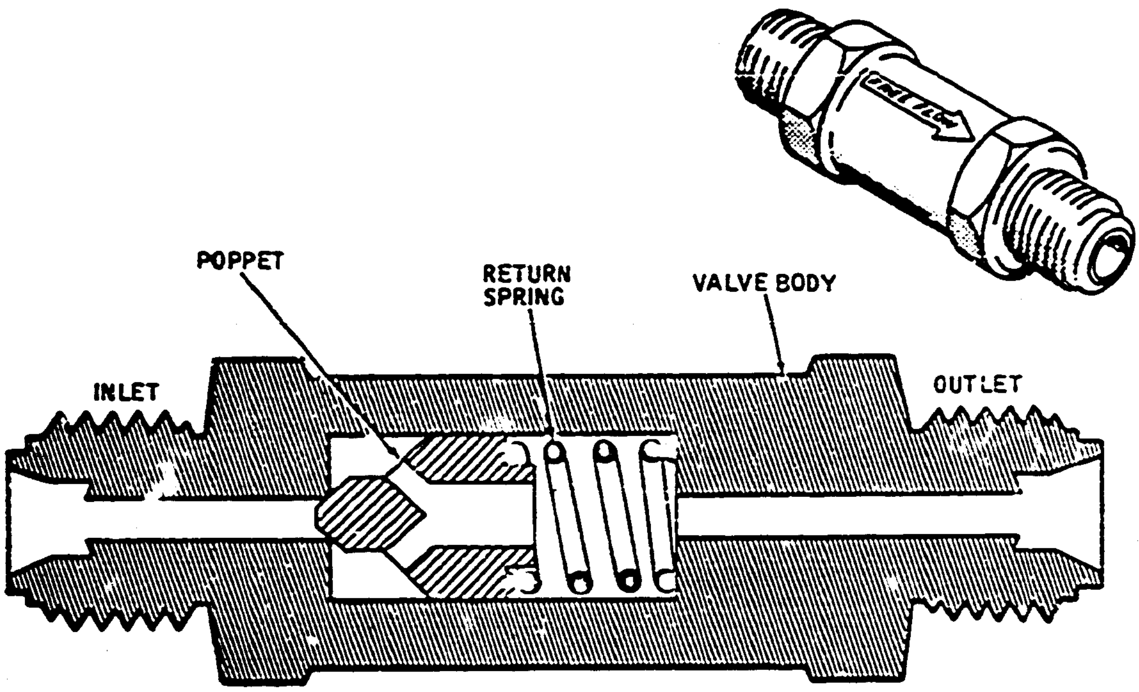


HA2-33

Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9



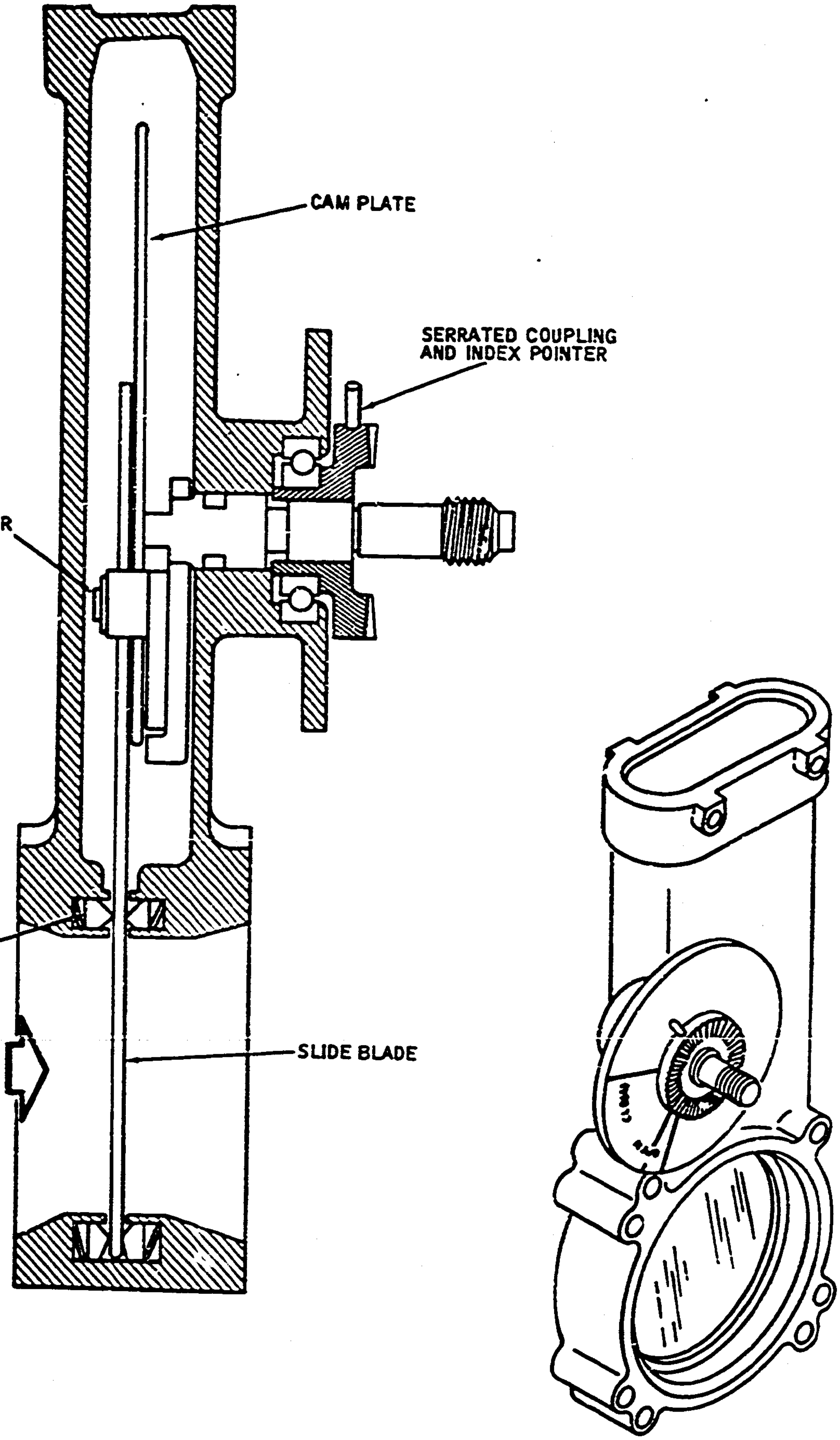
MINIATURE CHECK VALVE



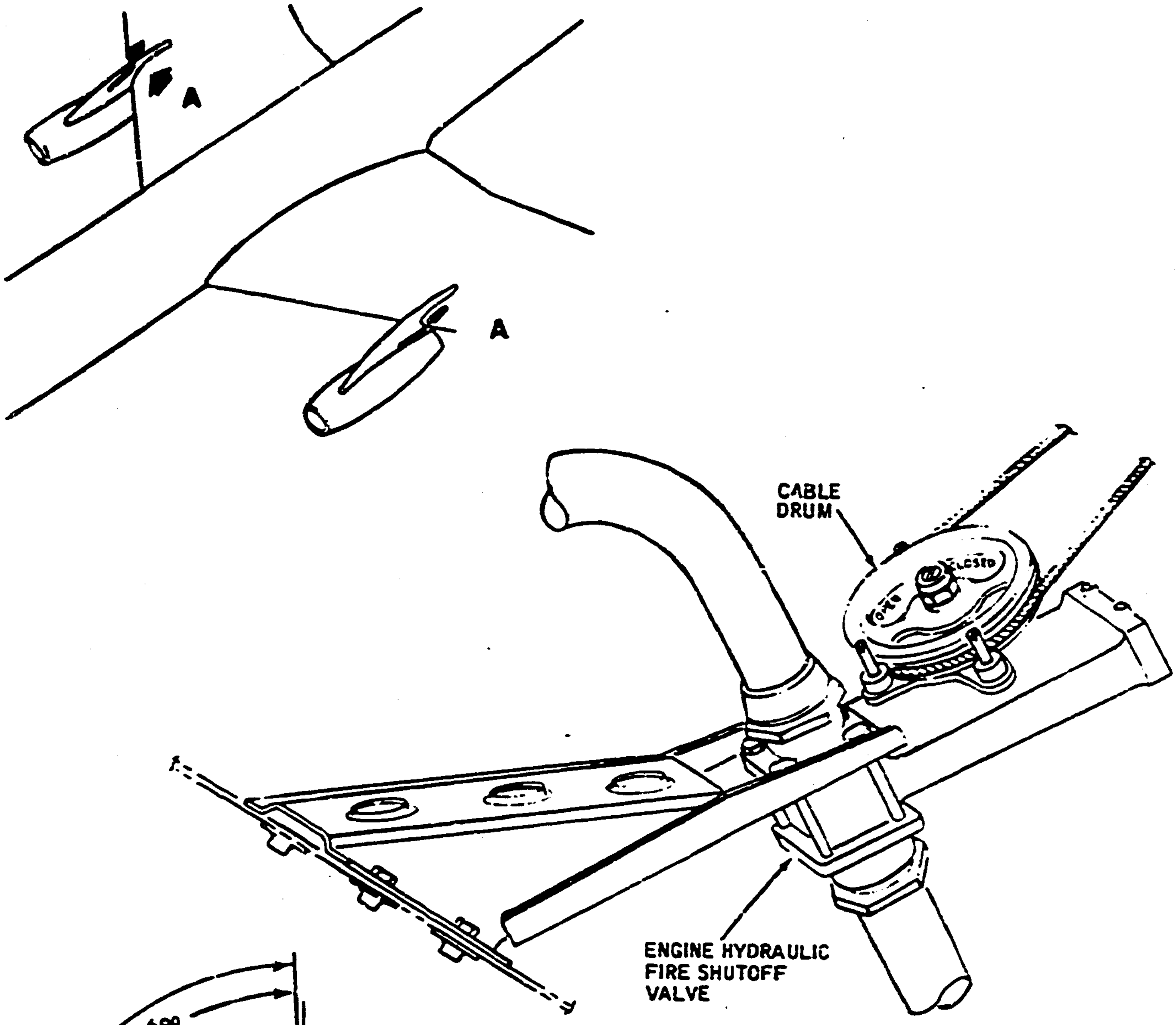
STANDARD CHECK VALVE

HA2-18A

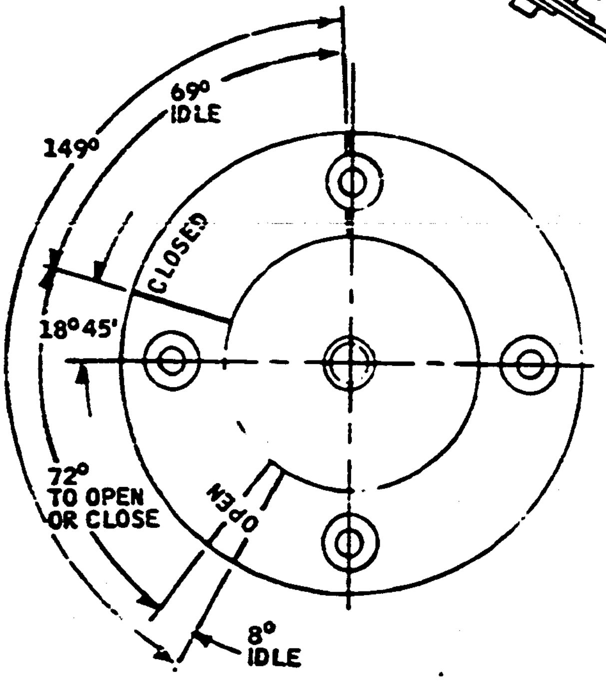
Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



VIEW A



VALVE POSITION DIAGRAM

HA2-22

Engine Hydraulic Fire Shutoff Valve
Figure 12

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

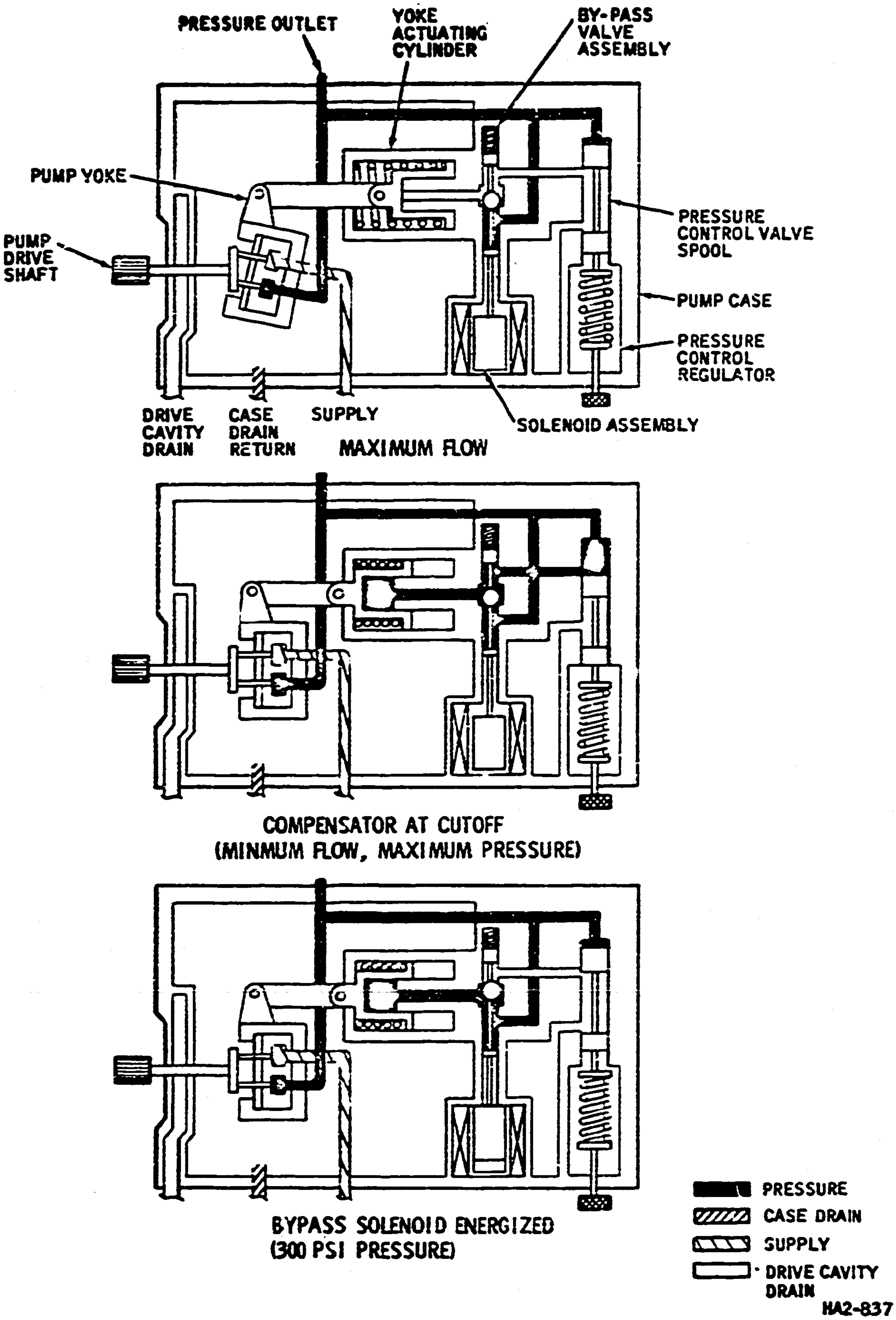
(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on



Engine-Driven Hydraulic Pump Pressure Flow -- Schematic
Figure 13

engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure down-stream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

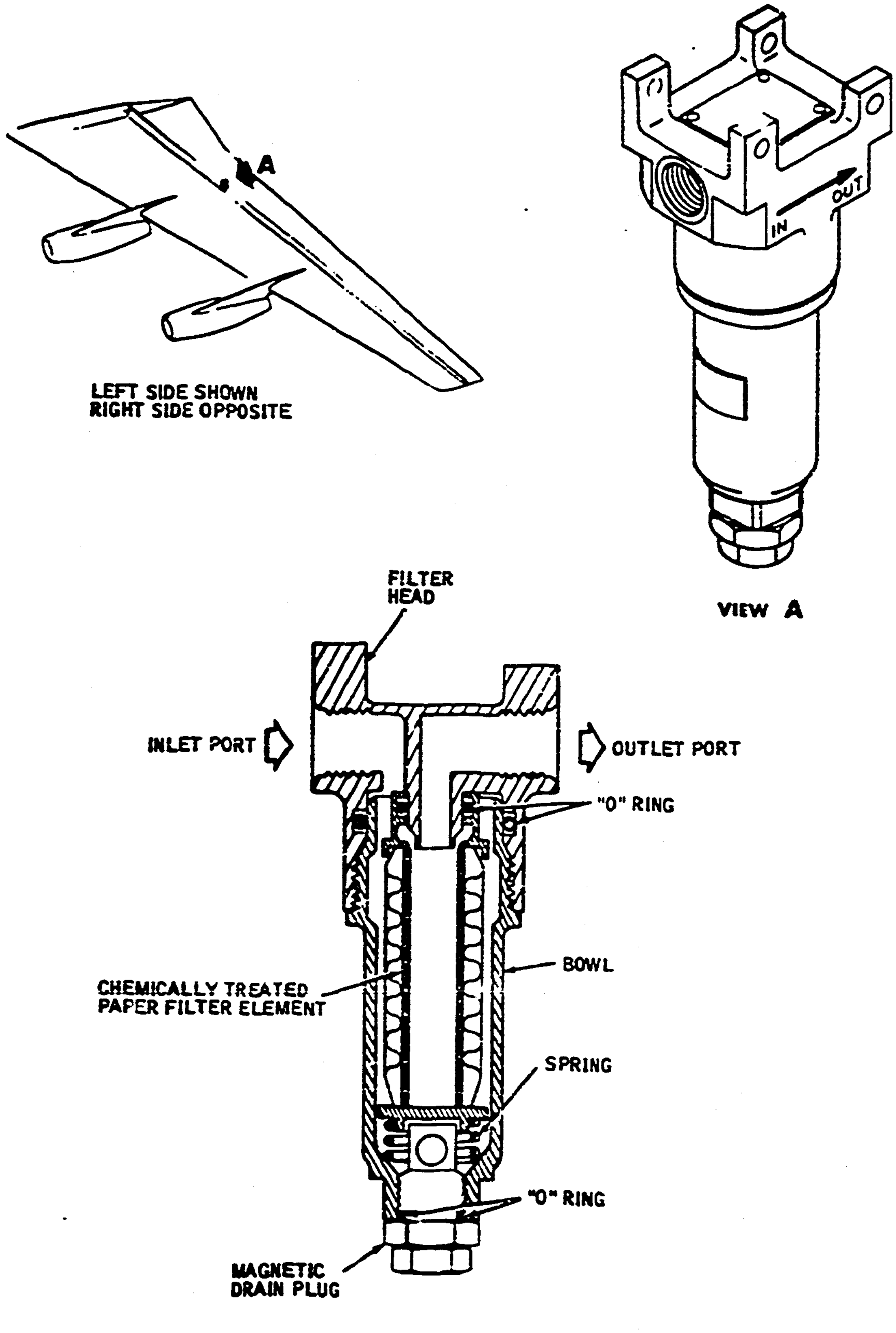
(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

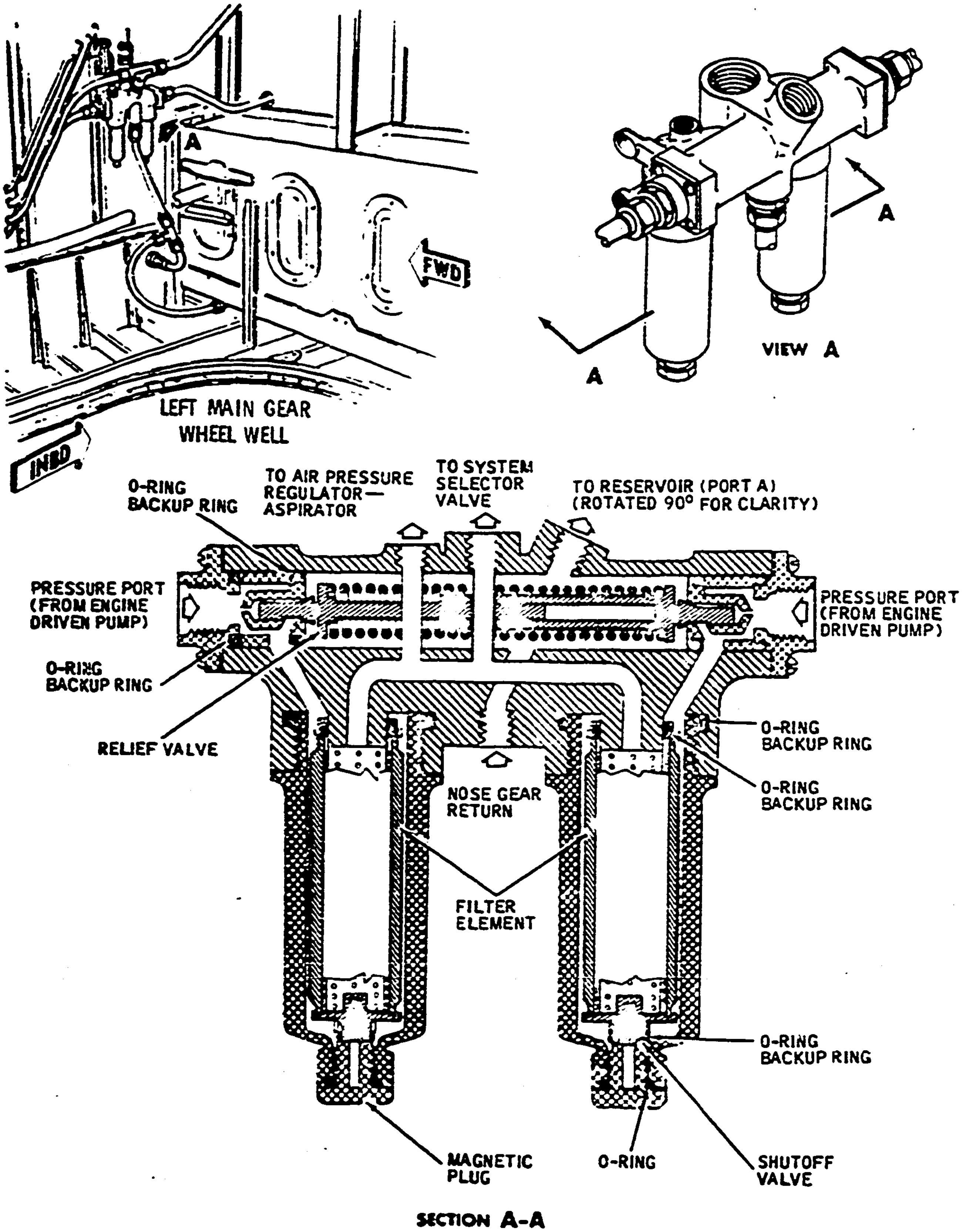
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve



HA2-31

Engine-Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



HA2-20

Dual Filter and Relief Valve -- Cutaway View
Figure 15

port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

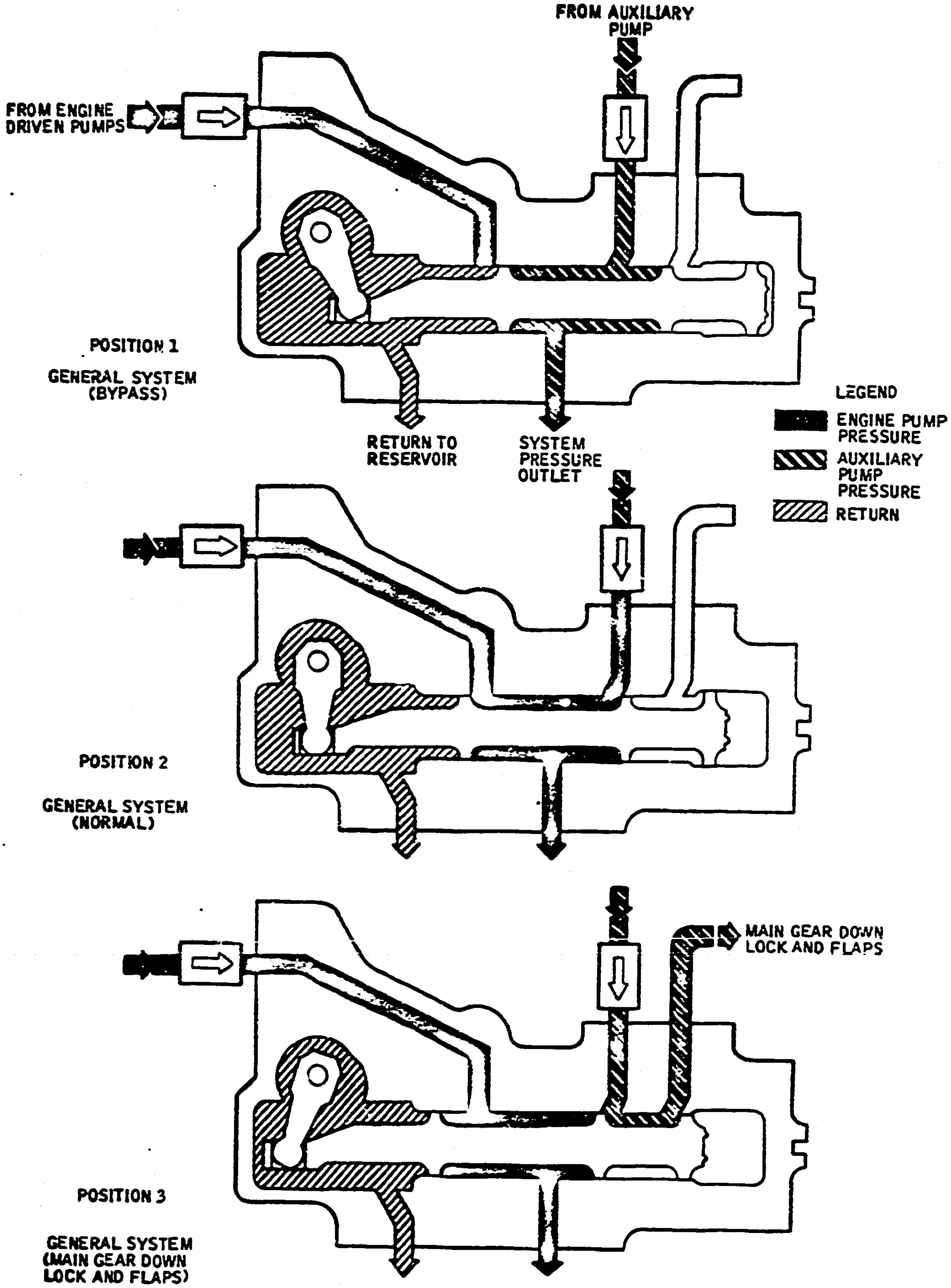
(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

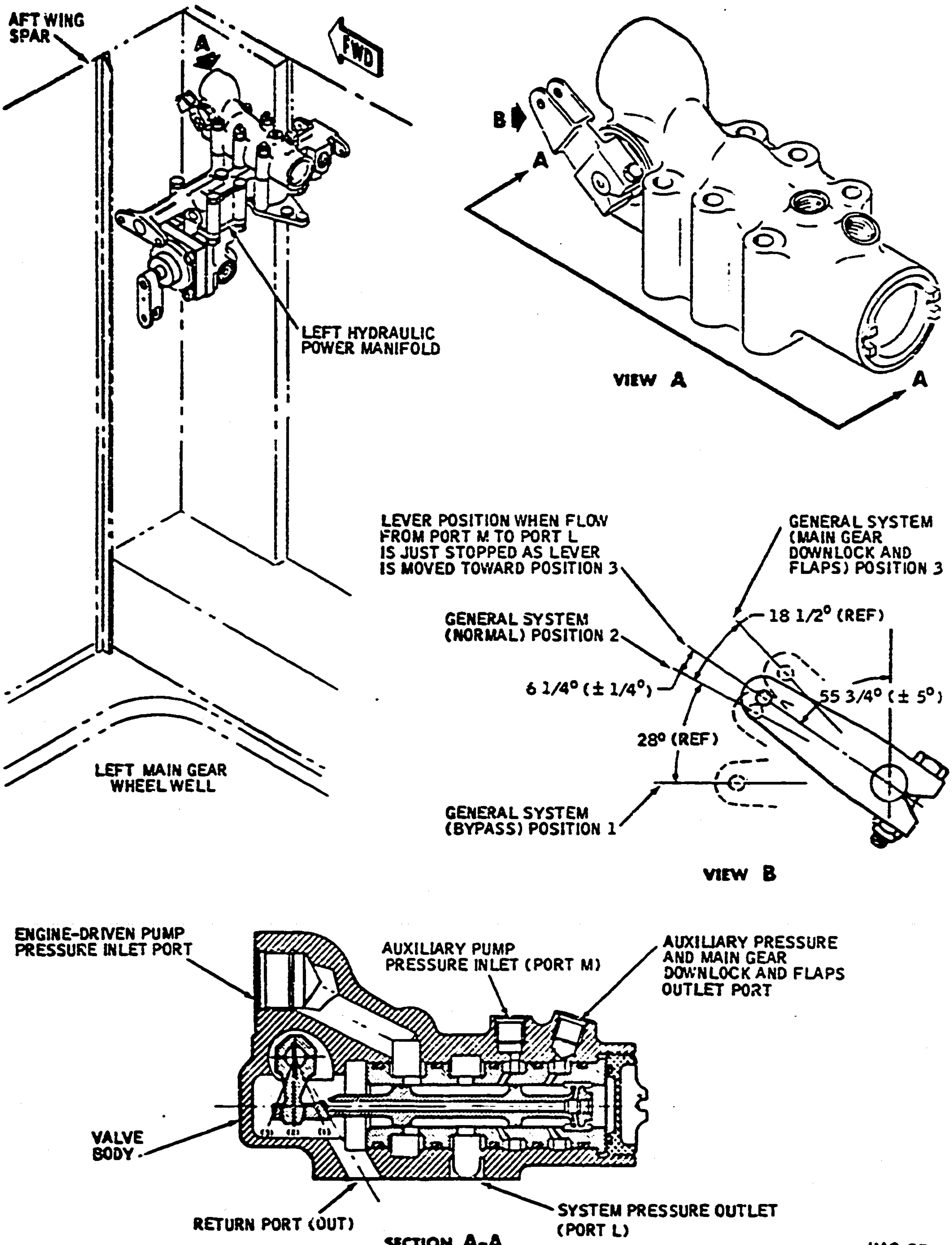
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17

flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

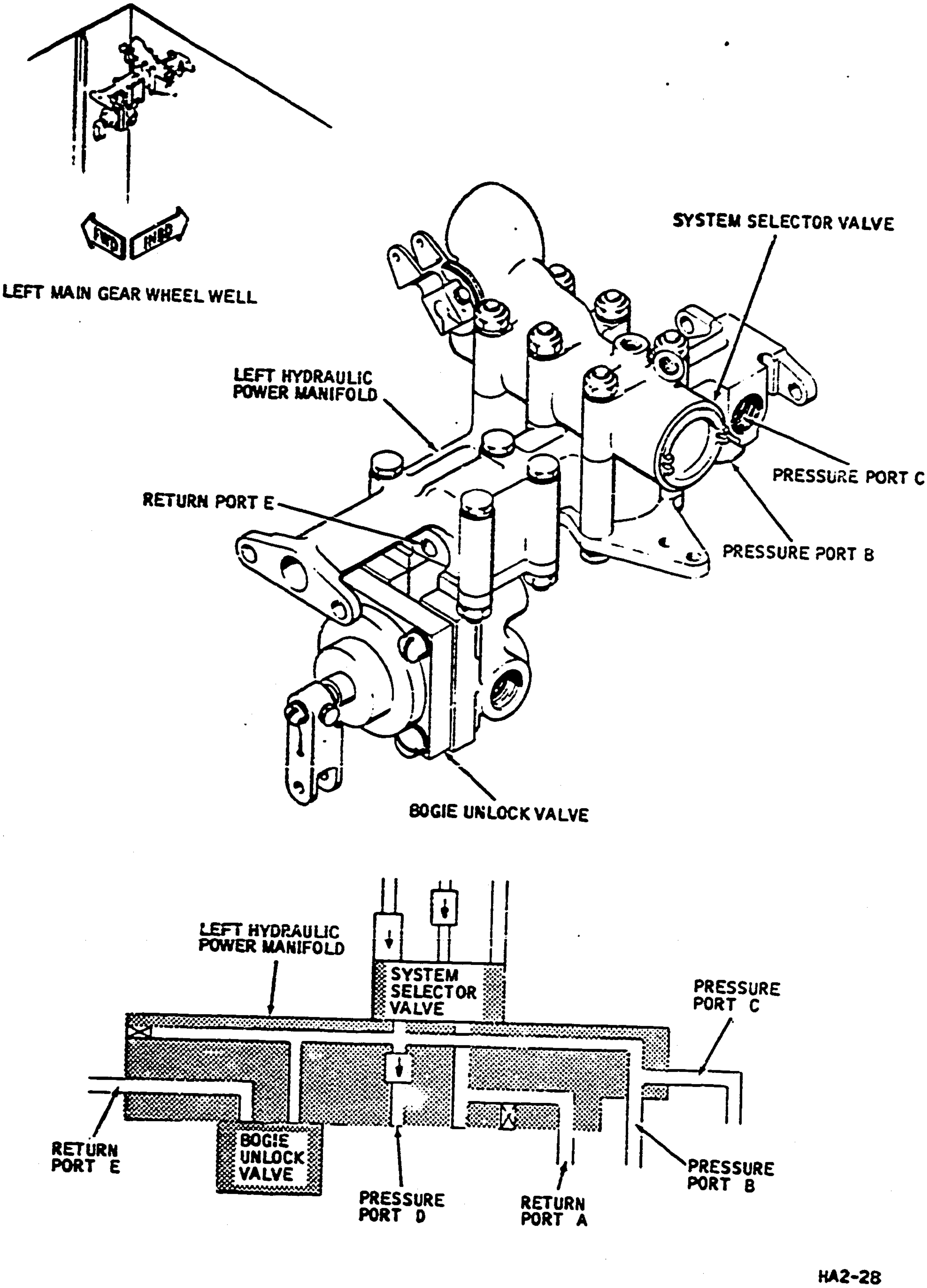
(2) Three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold pressure outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

Q. Right Hydraulic Power Manifold (See Figure 19.)

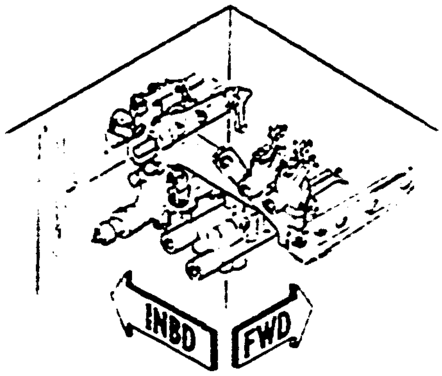
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

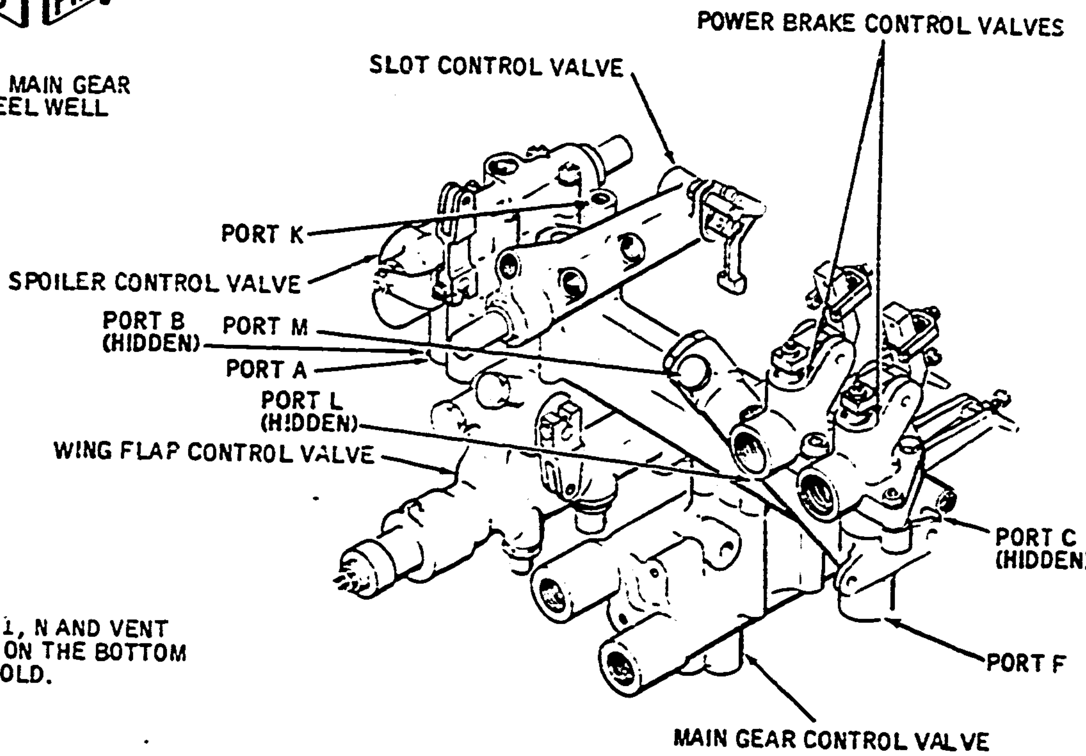
(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

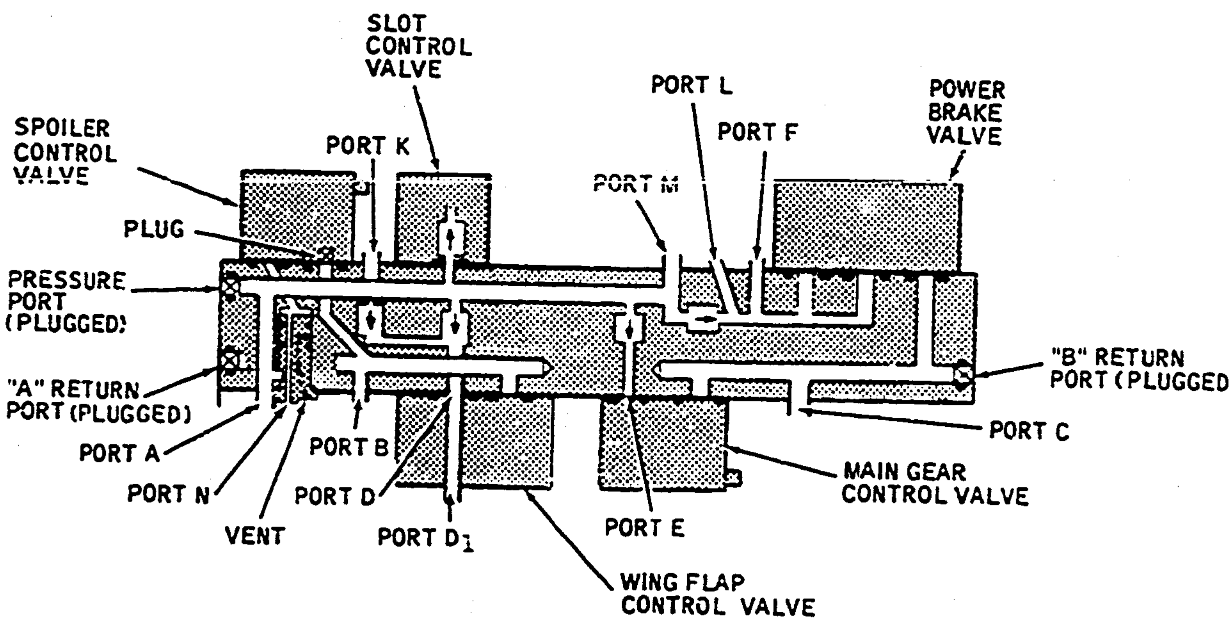


Left Hydraulic Power Manifold -- Schematic
Figure 18





NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Hydraulic Manifold Return Check Valves (See Figure 10.)

(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

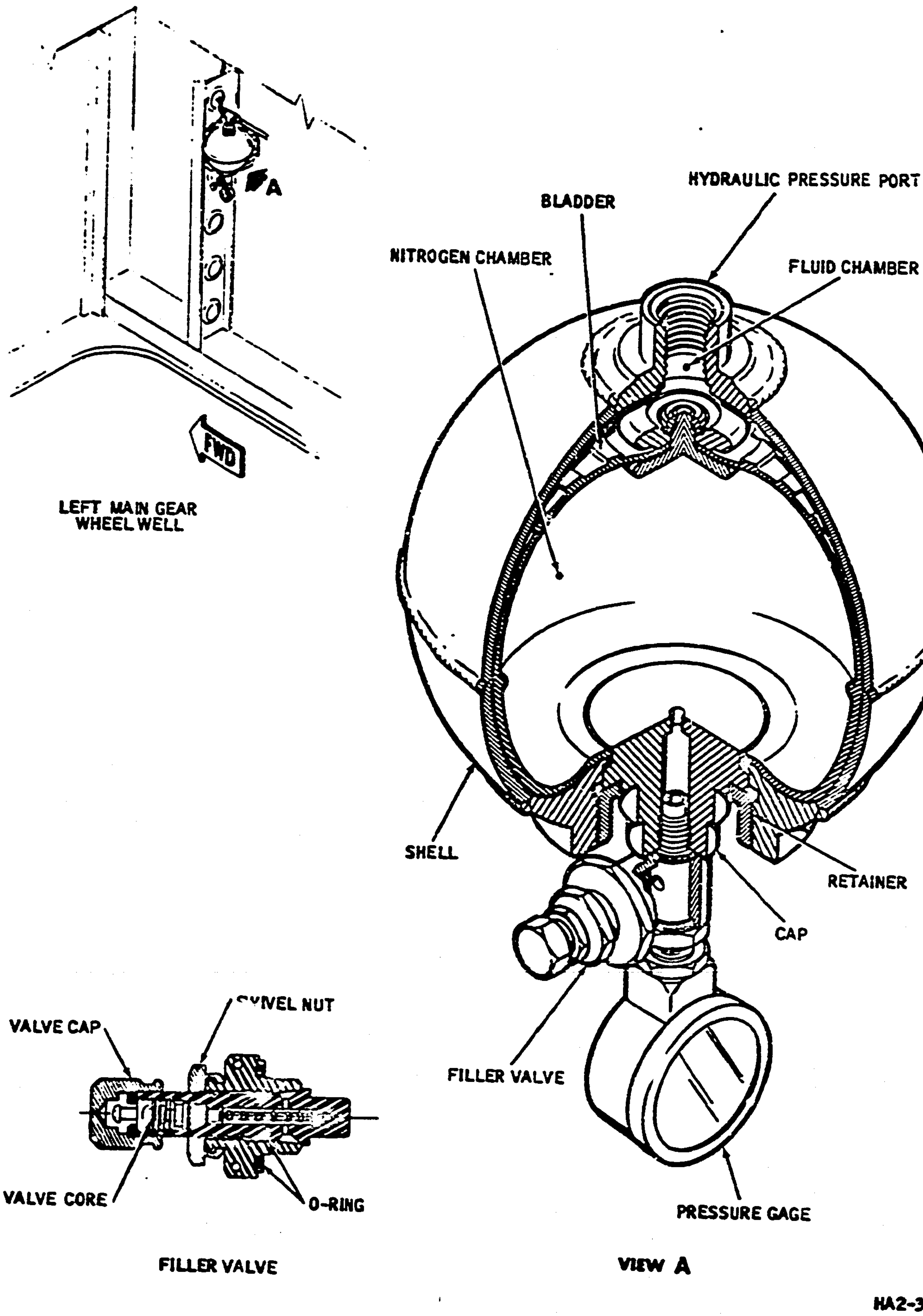
(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.



Hydraulic Power System Accumulator -- Cutaway View
Figure 20

T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

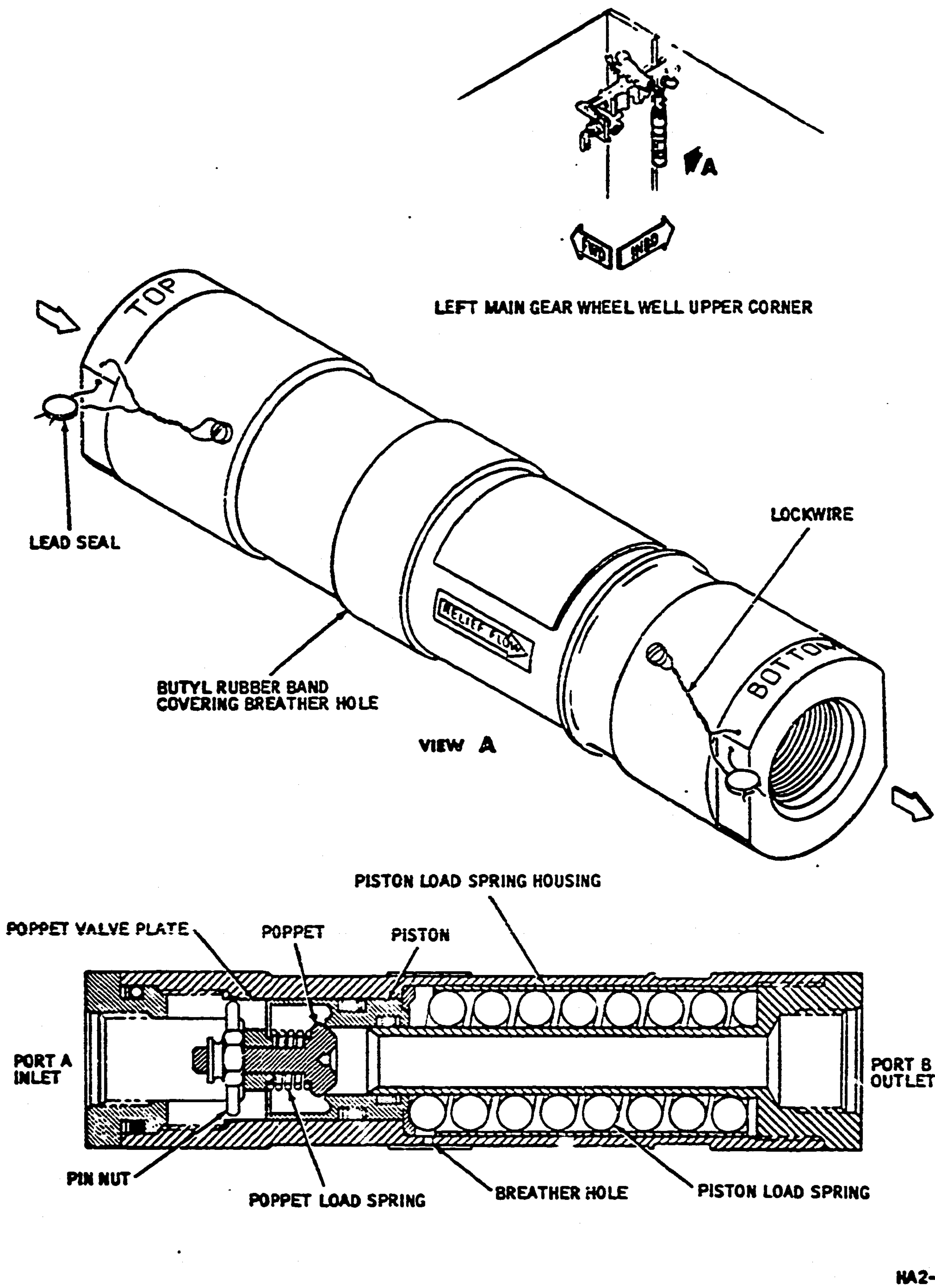
(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)



Hydraulic System Priority Valve -- Cutaway View
Figure 21

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low stand-pipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

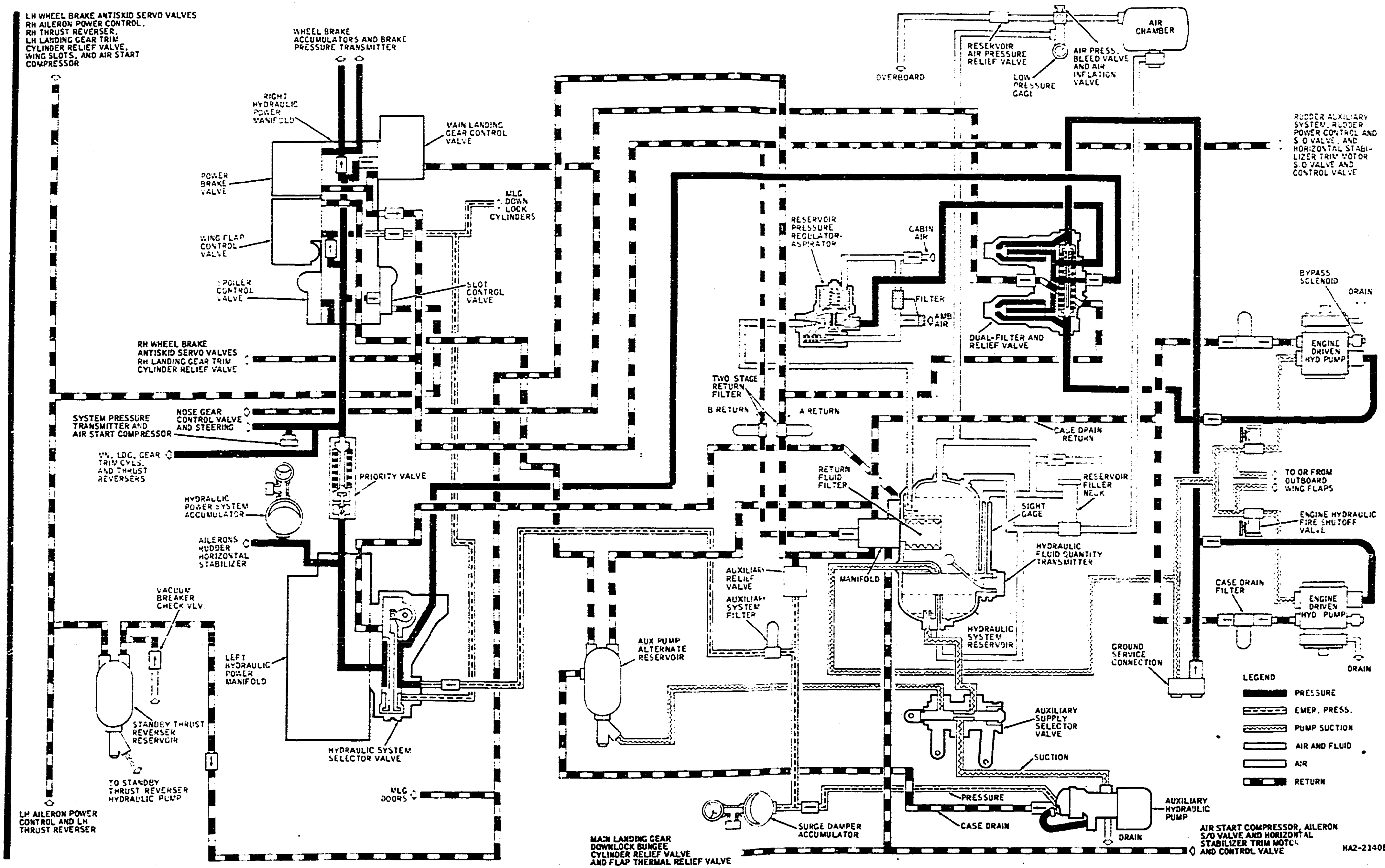
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram
Figure 1

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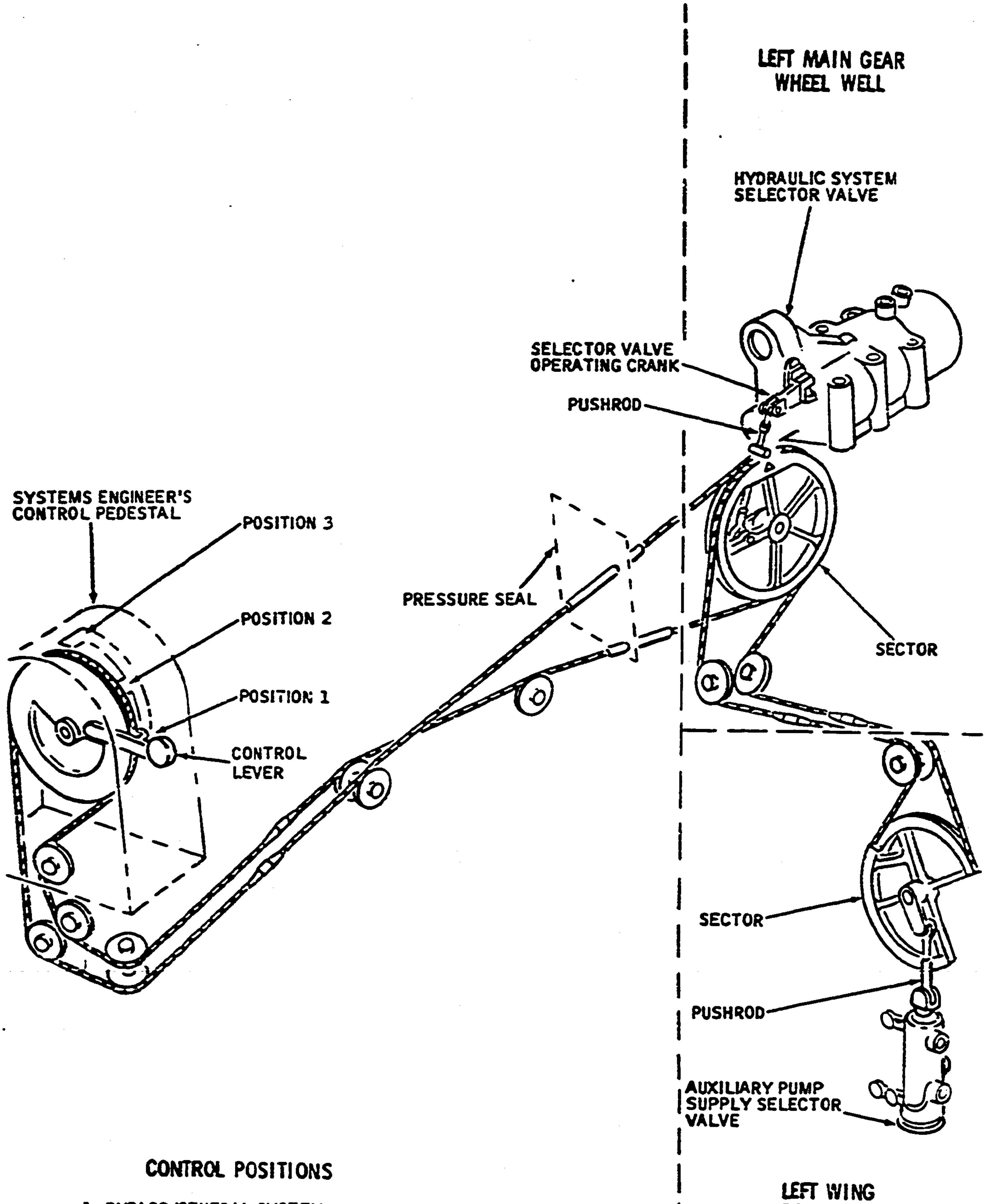


CONTROL POSITIONS

1. BYPASS/GENERAL SYSTEM
2. GENERAL SYSTEM (NORMAL)
3. GENERAL SYSTEM/MAIN GEAR DOWN AND FLAPS

HA2-486

Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear, system pressure transmitter, thrust reverser shutoff valve, air start compressor and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff.

(6) The right power manifold distributes fluid pressure to the brake accumulators, the brake pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake.

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the wing flap outboard cylinder is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to the bypass return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the systems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate pressure line, runs directly to a shuttle valve in the main gear down lock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinders' downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, cables the system selector valve sector and pushrod, the system selector valve, the auxiliary hydraulic pump supply selector valve sector and pushrod, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into detents at each general system (normal) position, and is connected to the control lever cable drum. Two calbes run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

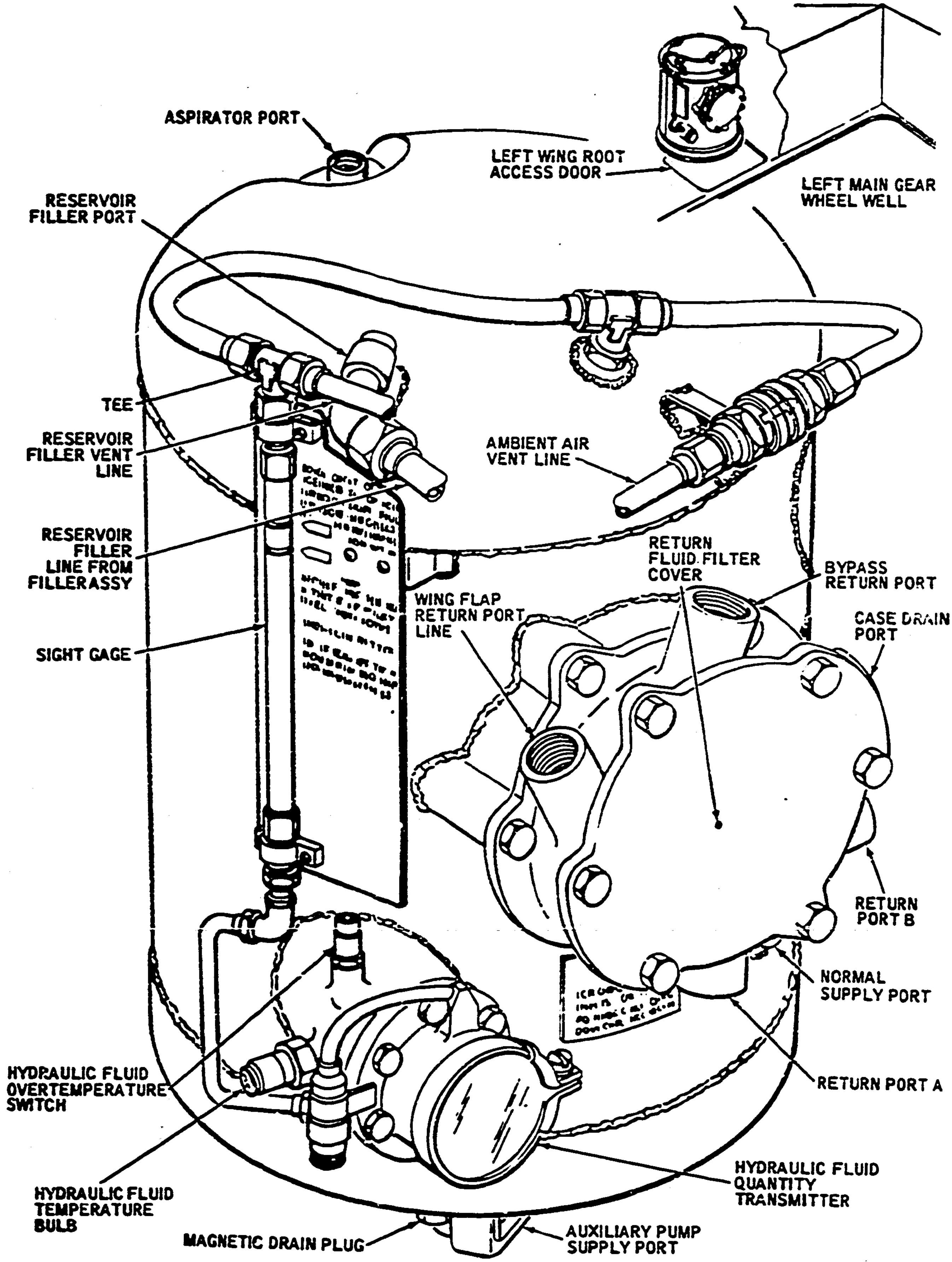
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

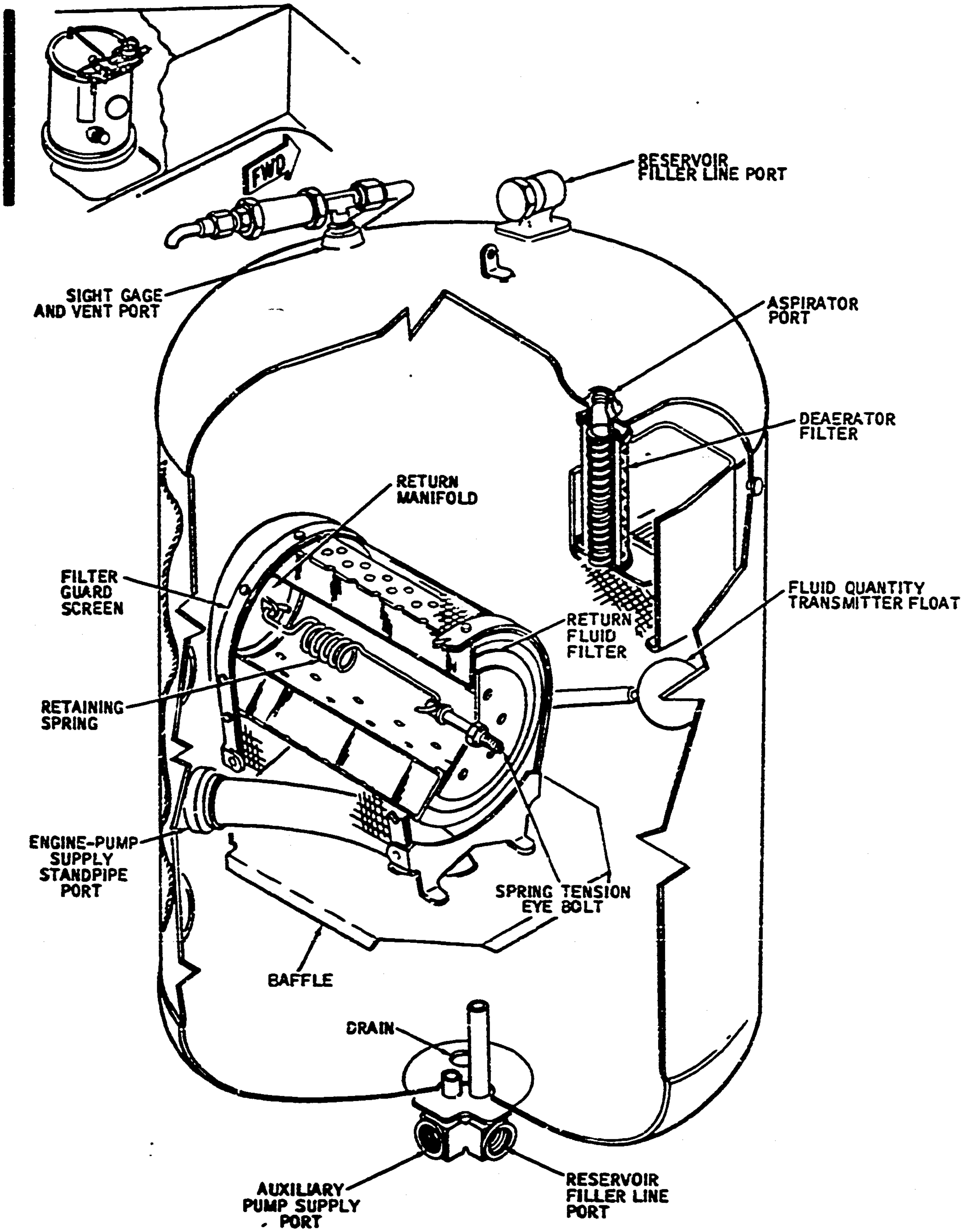
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of

six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

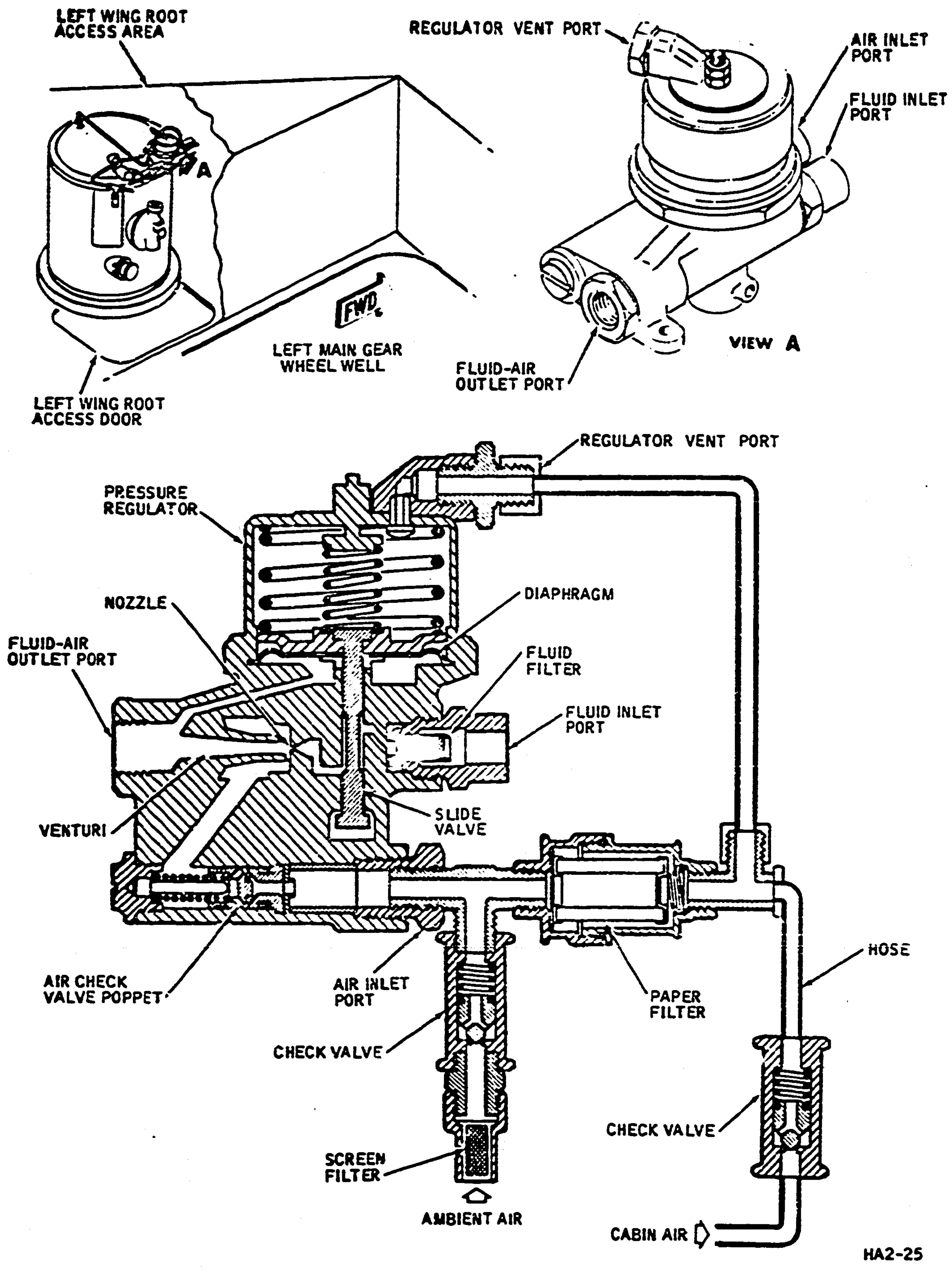
(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

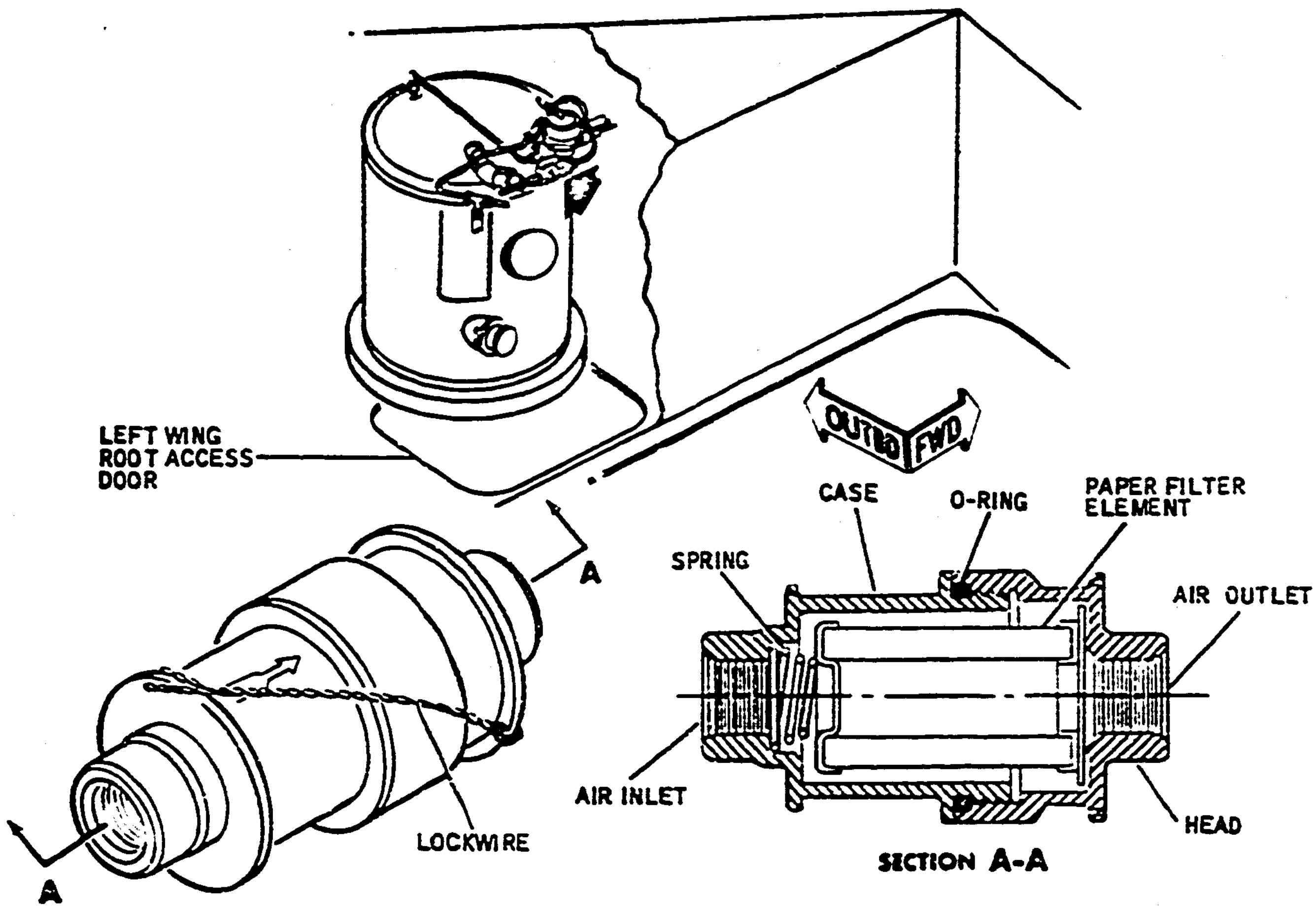
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

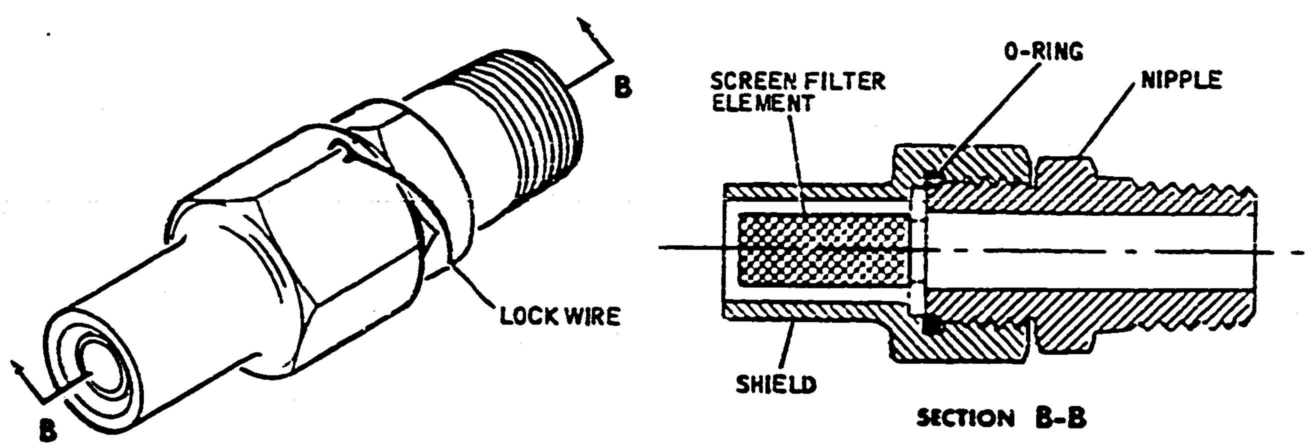
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.



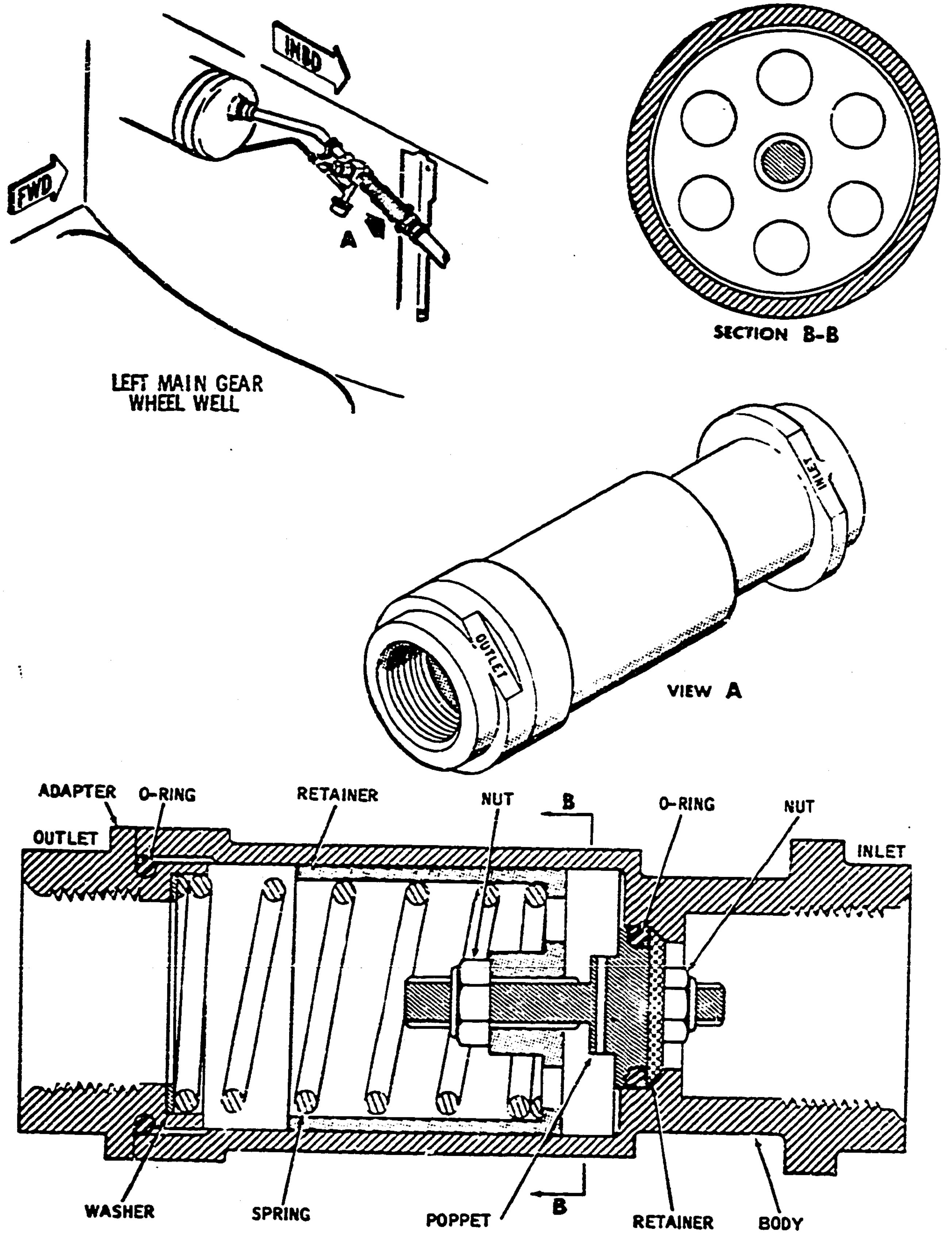
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



Hydraulic Reservoir Relief Valve
Figure 7

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

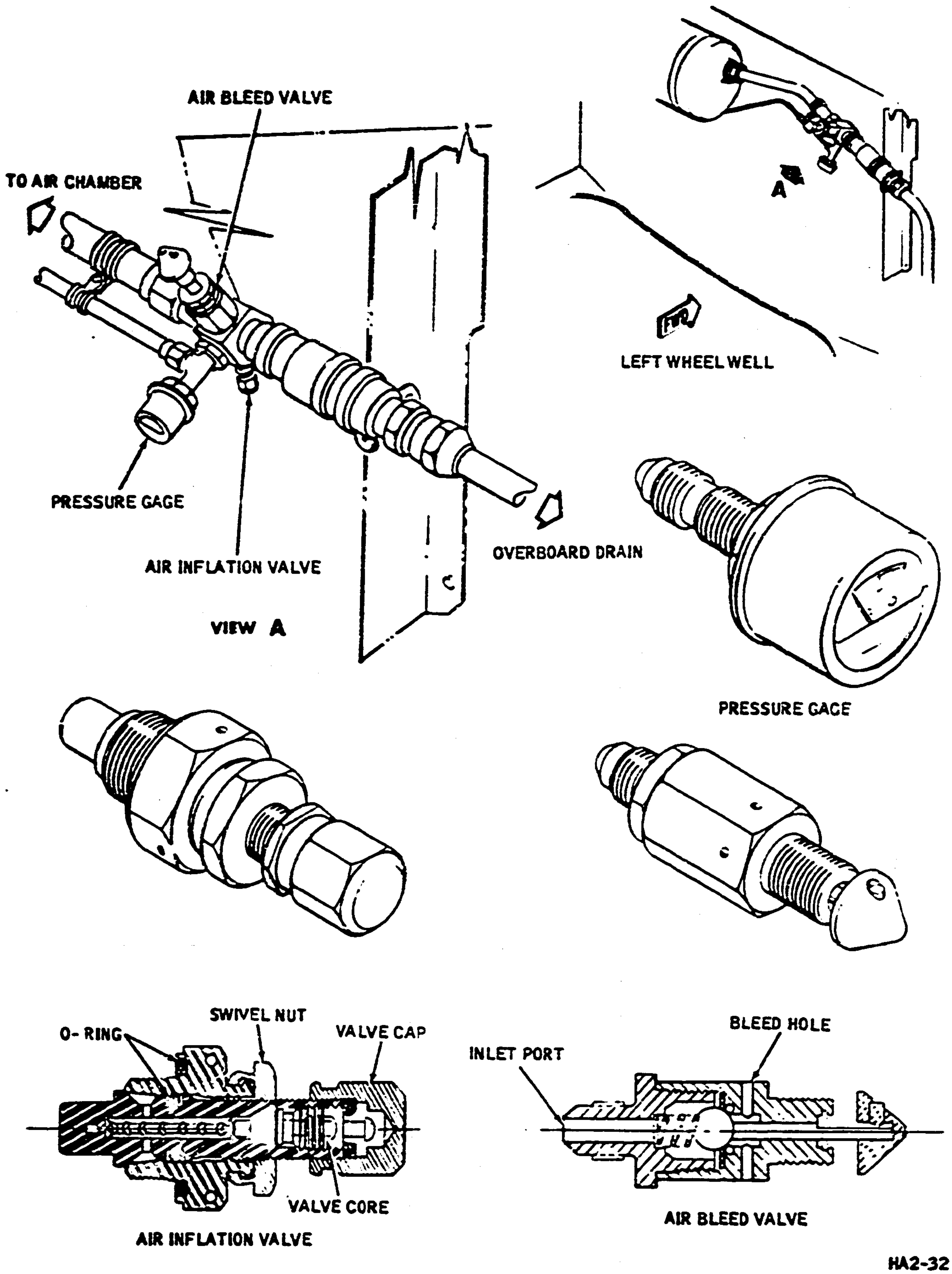
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted



Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage
Figure 8

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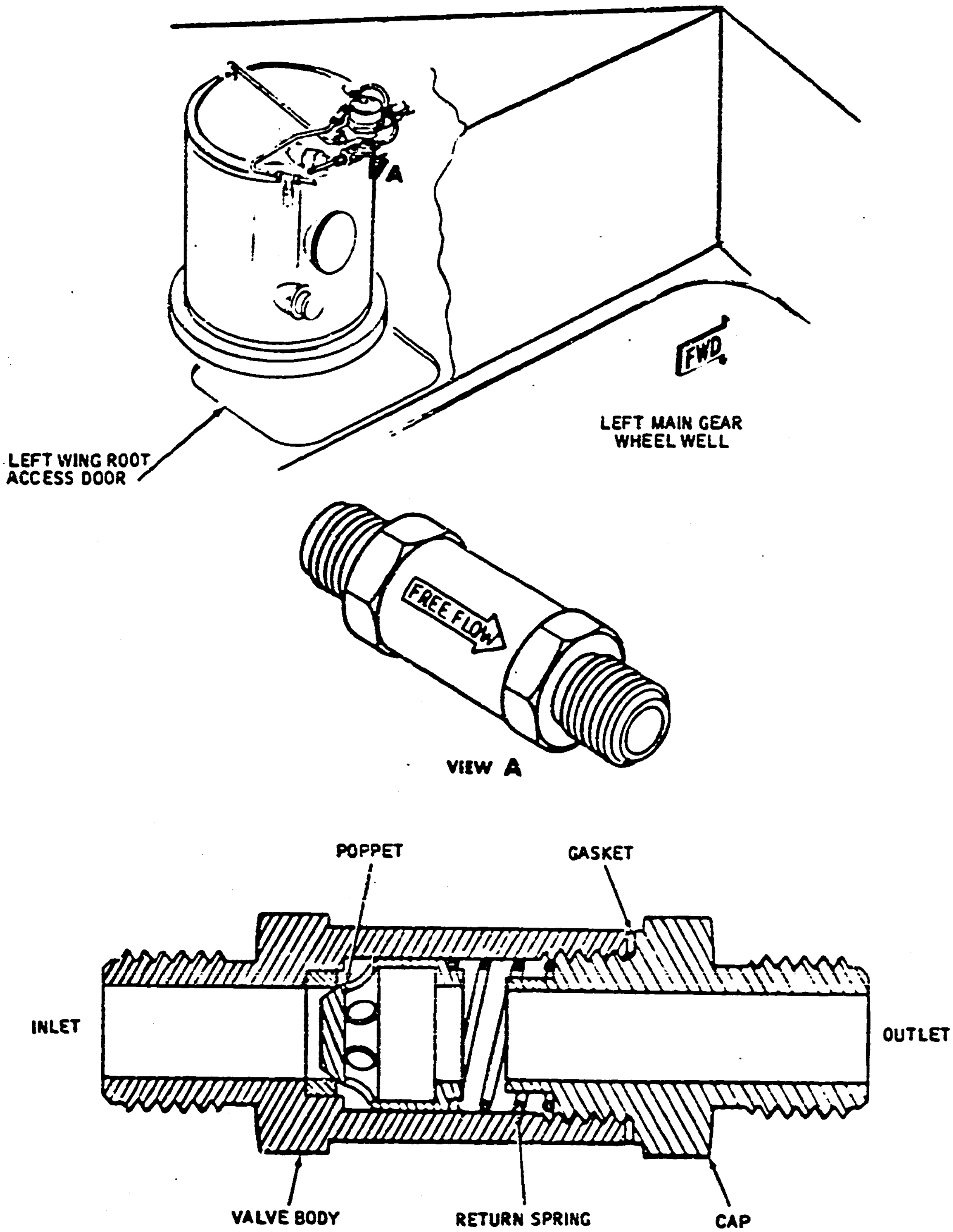

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Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

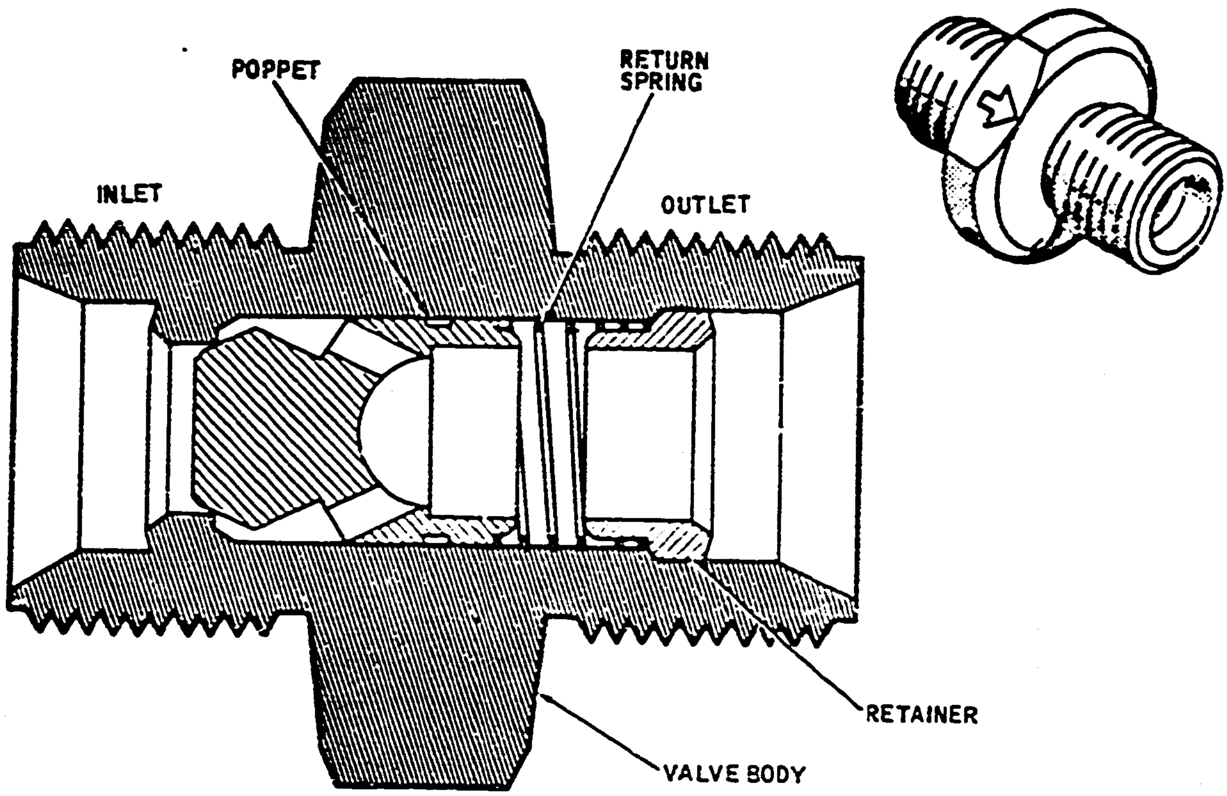
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

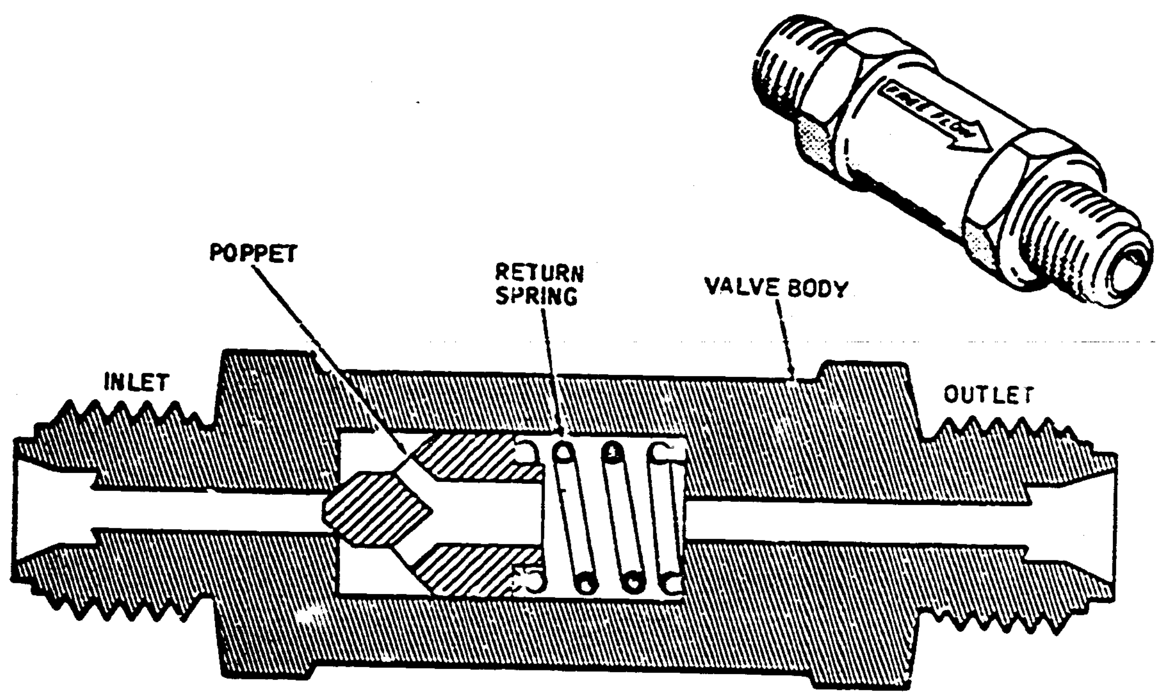
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.



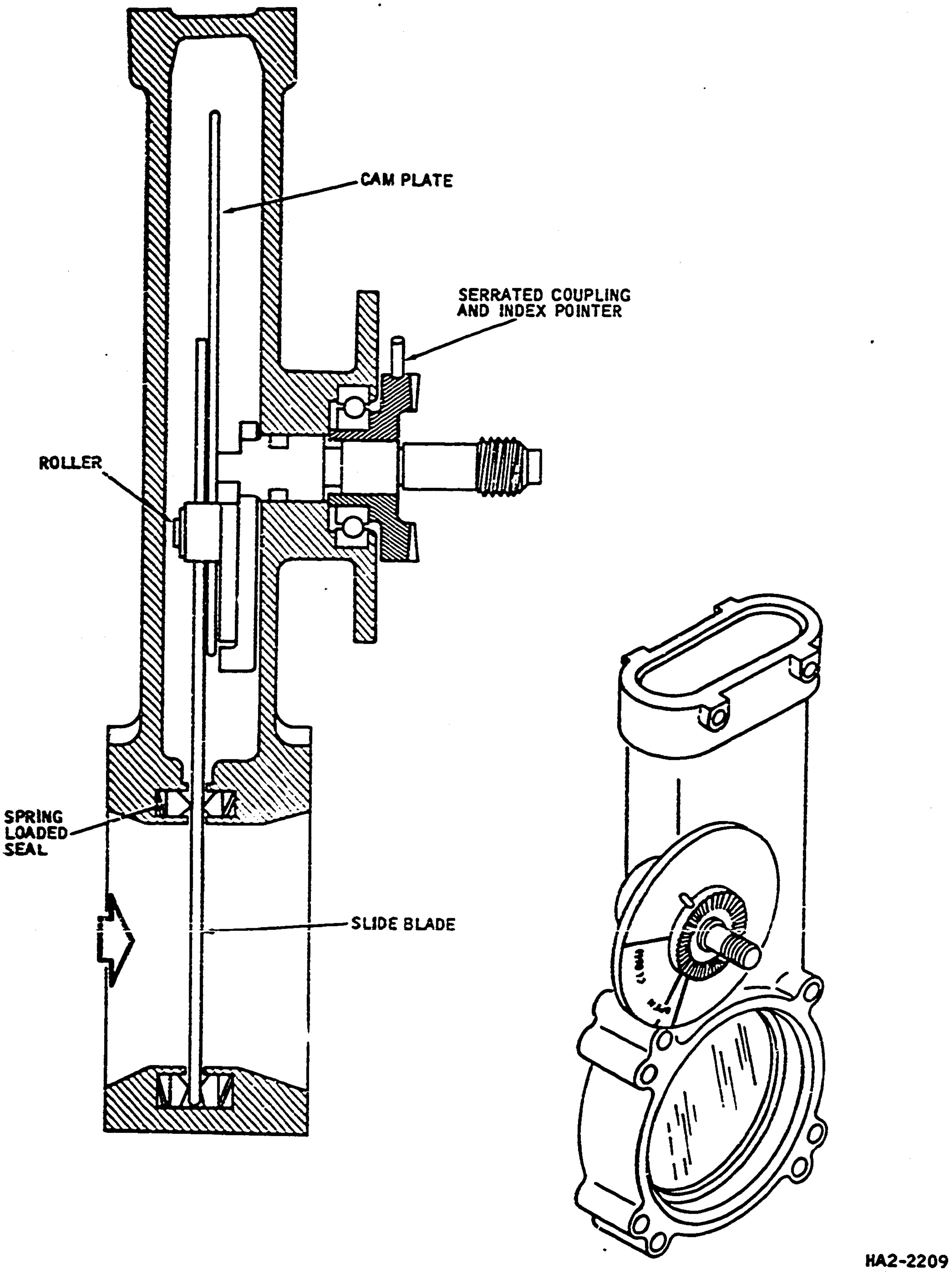
MINIATURE CHECK VALVE



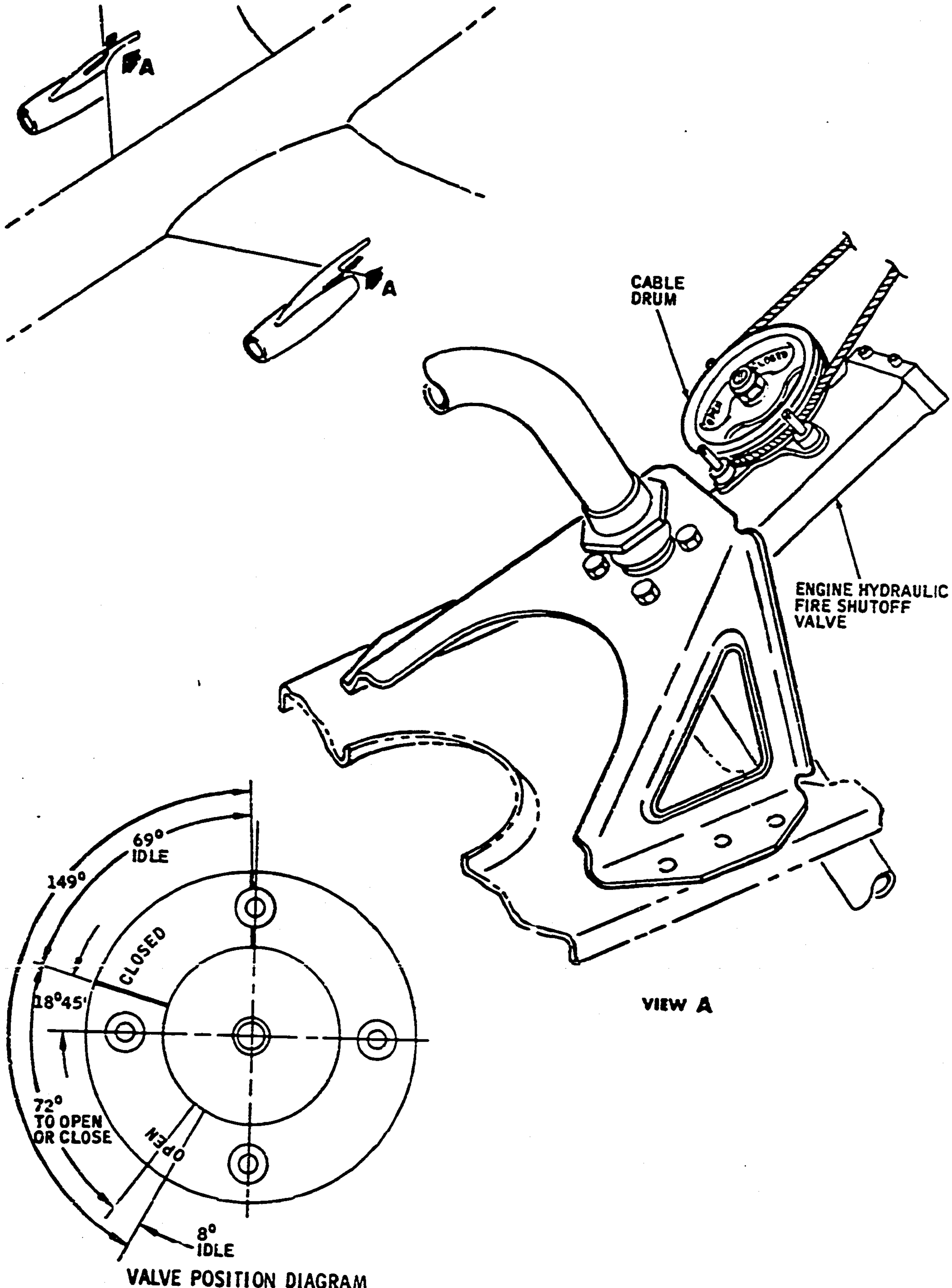
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

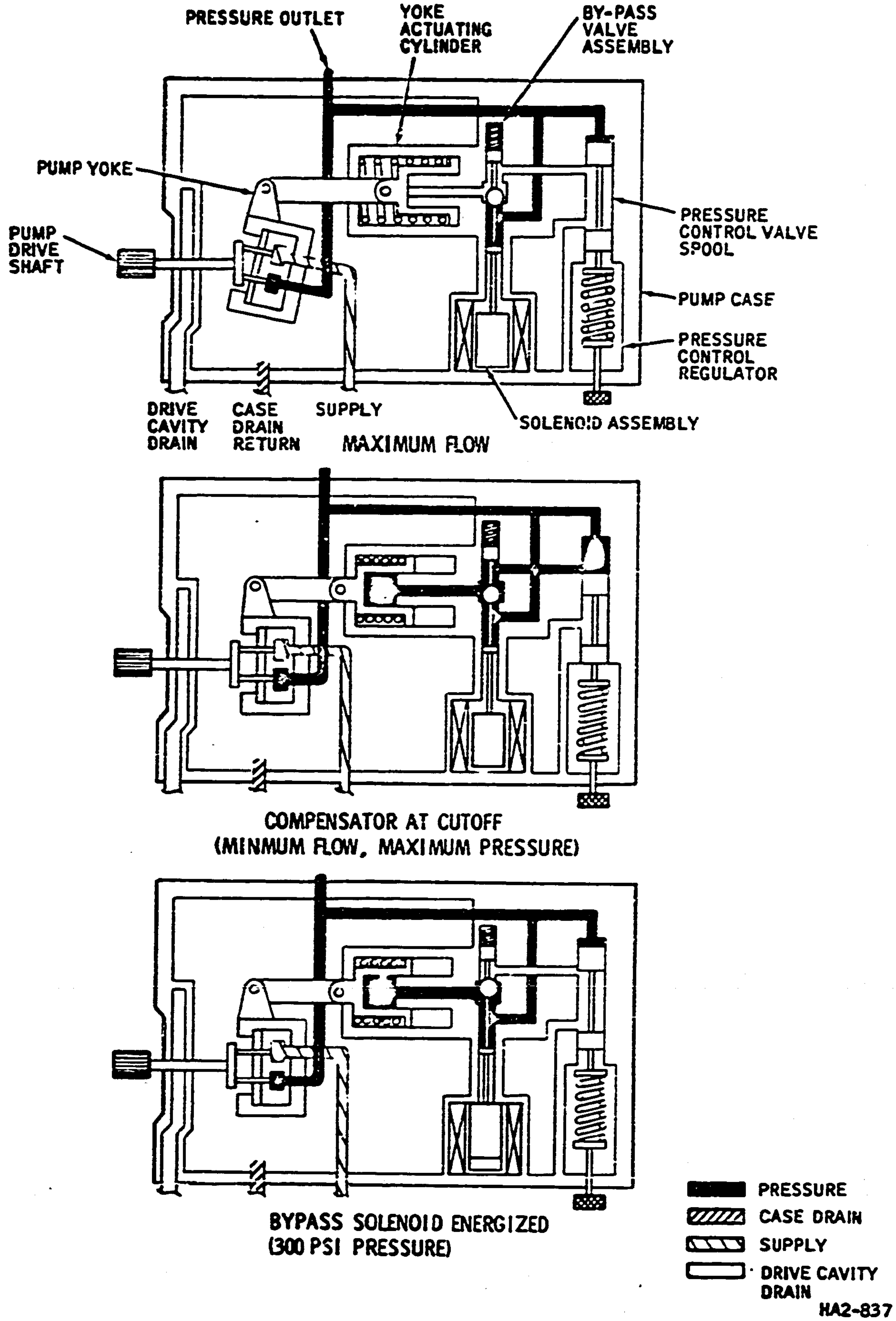
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gate will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.



Engine-Driven Hydraulic Pump Pressure Flow -- Schematic
Figure 13

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating driven shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

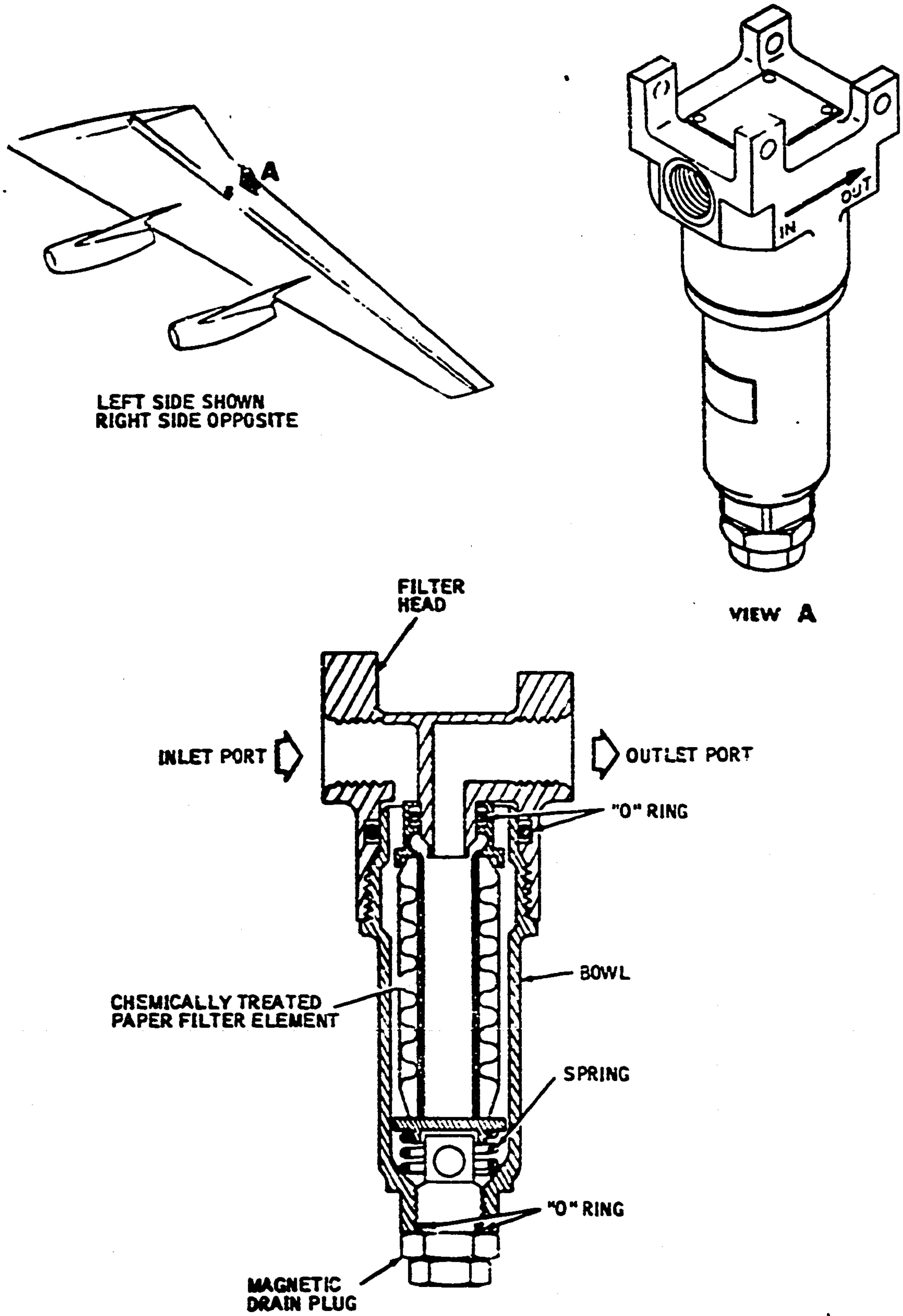
L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevent. reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.



HA2-31

Engine-Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

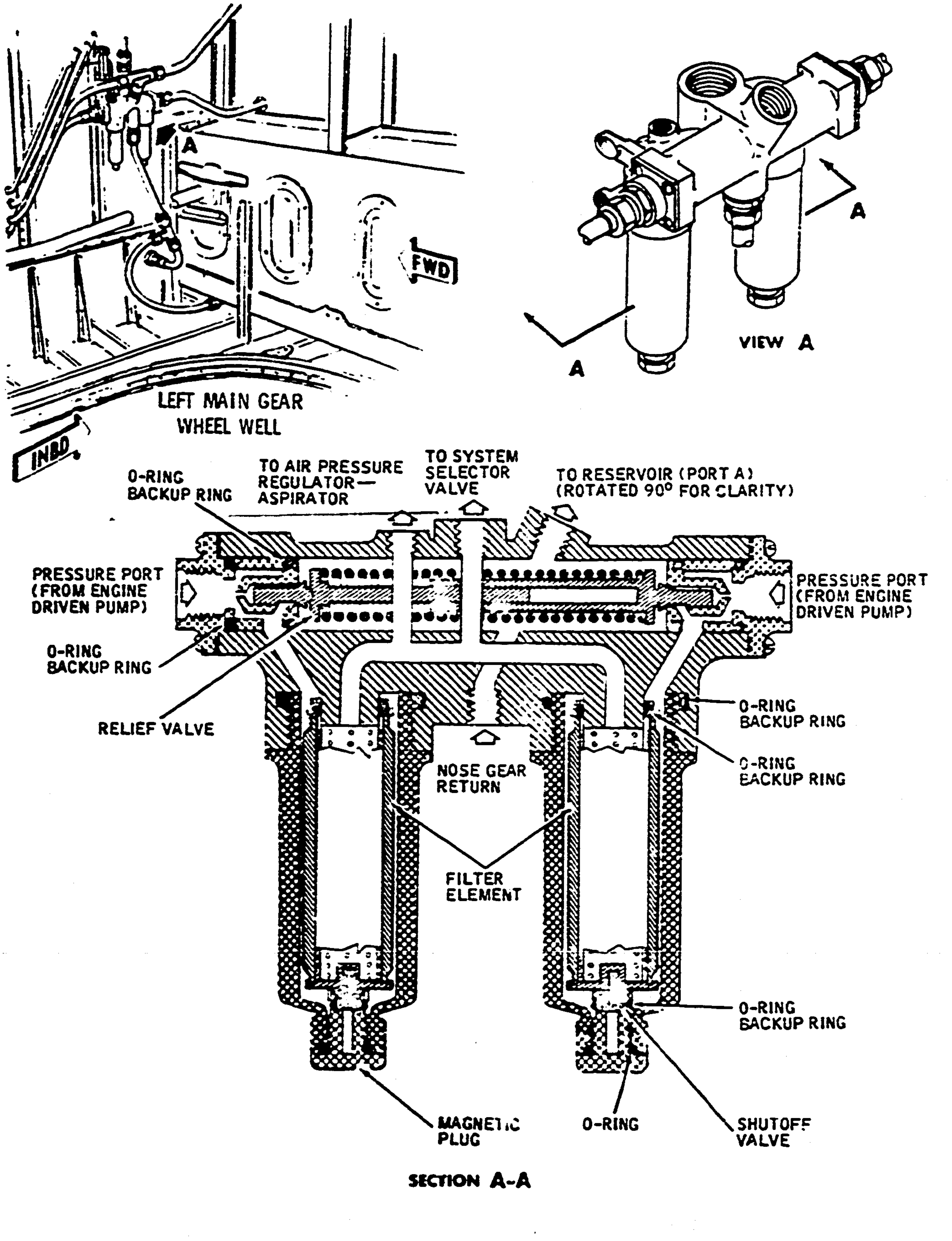
(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

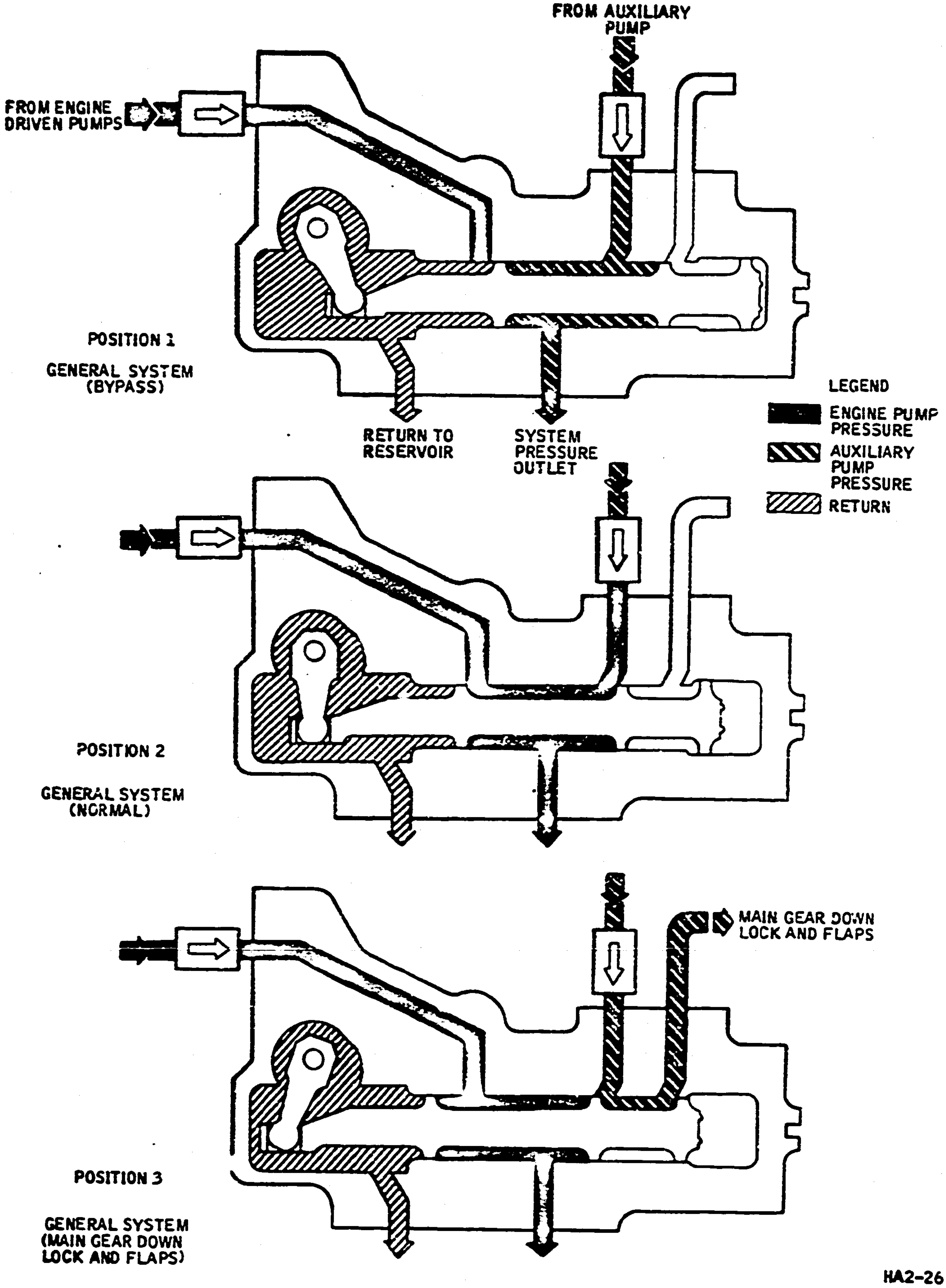
(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

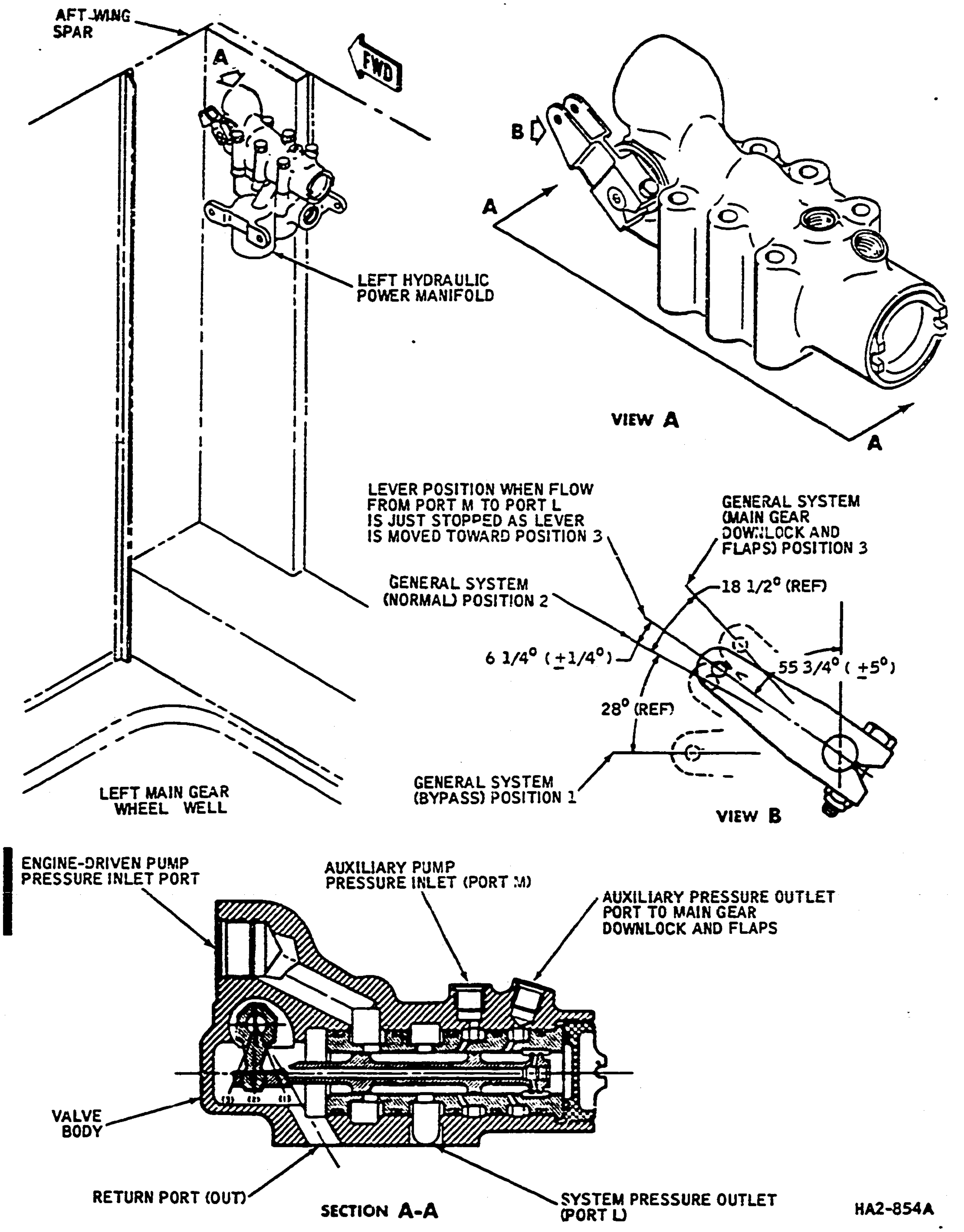
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.



Dual-Filter and Relief Valve -- Cutaway Valve
Figure 15



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17

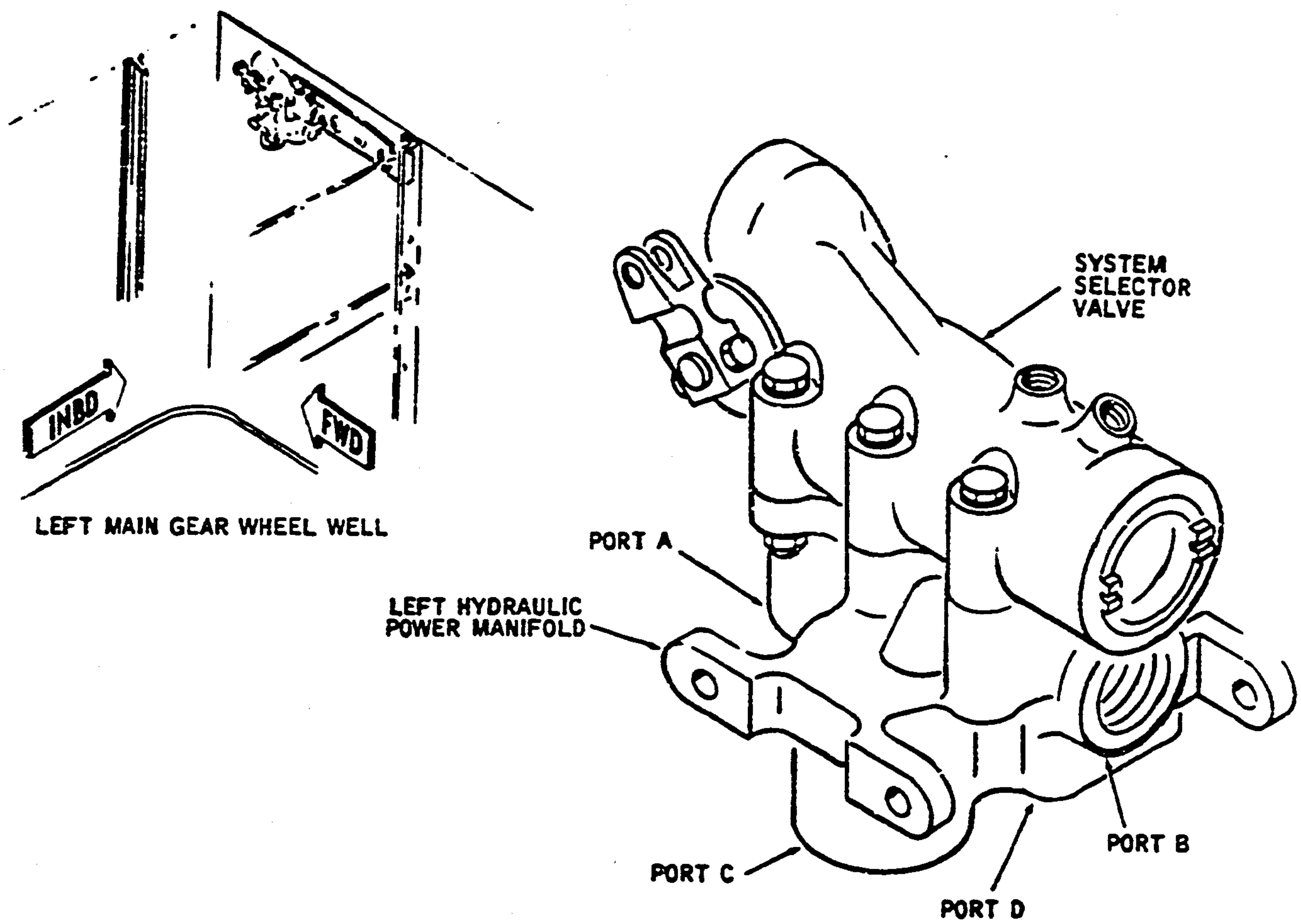
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

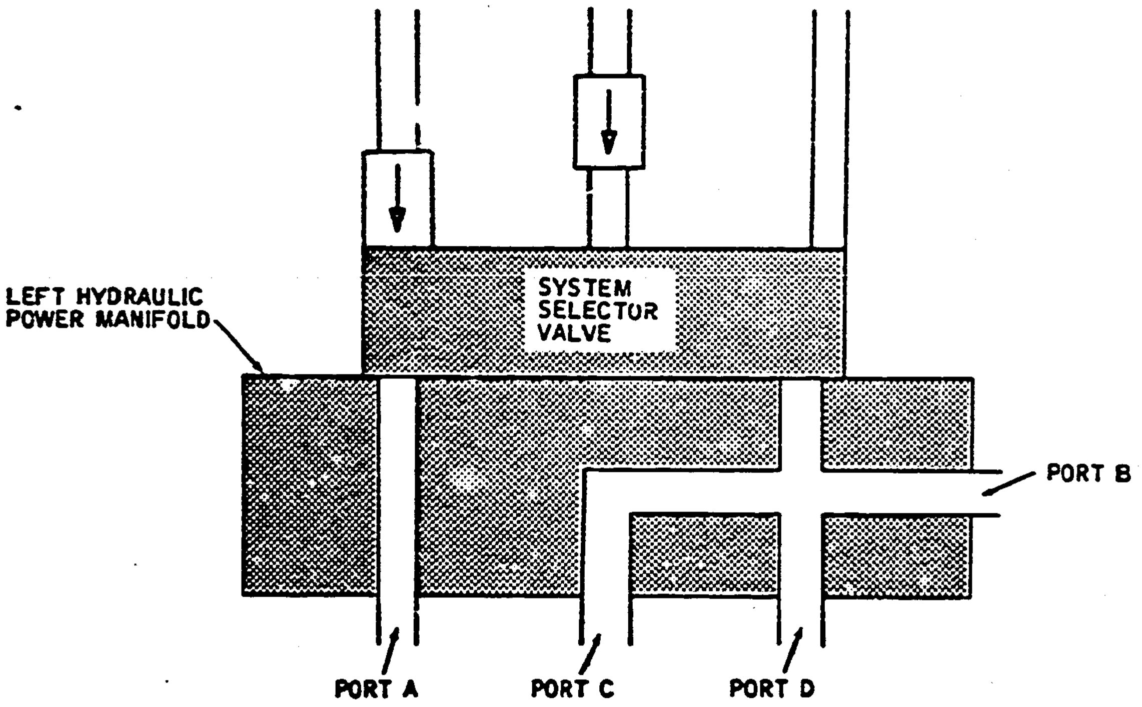
(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, allowing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, auxiliary pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls and the main system accumulator. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear, system pressure transmitter, air start compressor, bogie trim cylinders, thrust reverser shutoff valve, and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.





HA2-855

Left Hydraulic Power Manifold -- Schematic
Figure 18

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

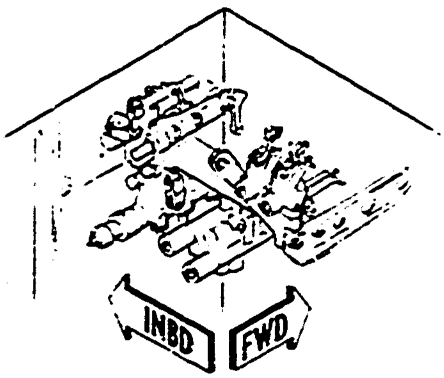
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located outboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

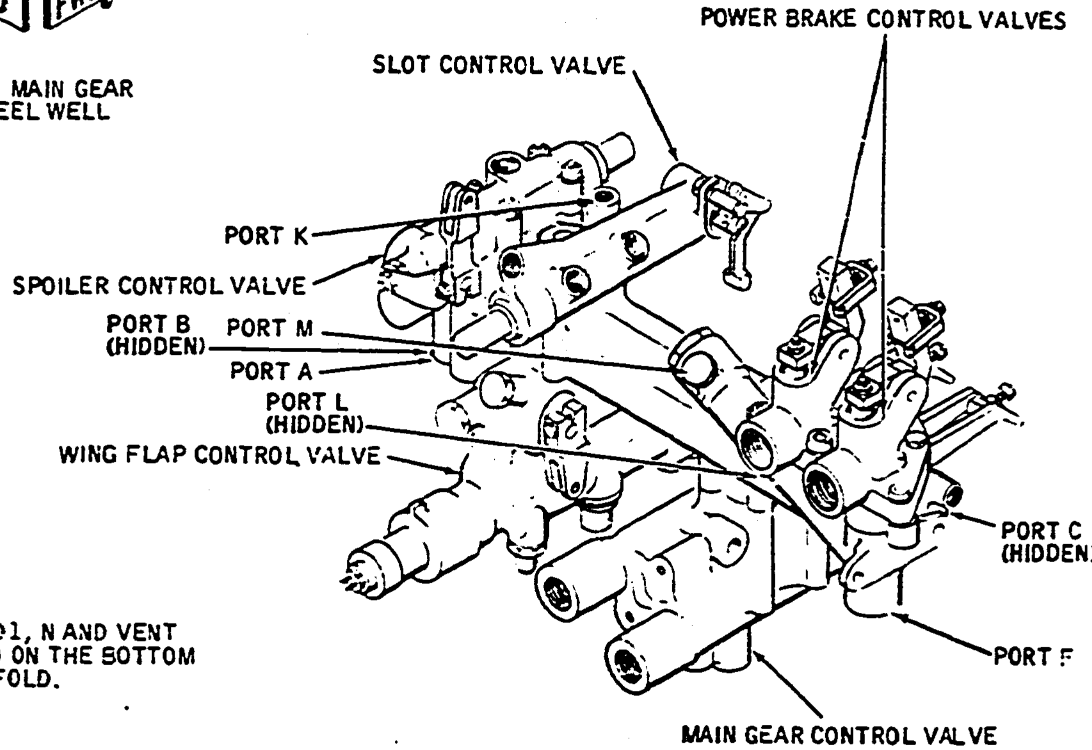
(5) The return passage from the wing flap control valve ports fluid out of return port B. The brake control valve return passage ports fluid into return line B through a check valve. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port C, in the manifold as the brake control valve.

R. Deleted.

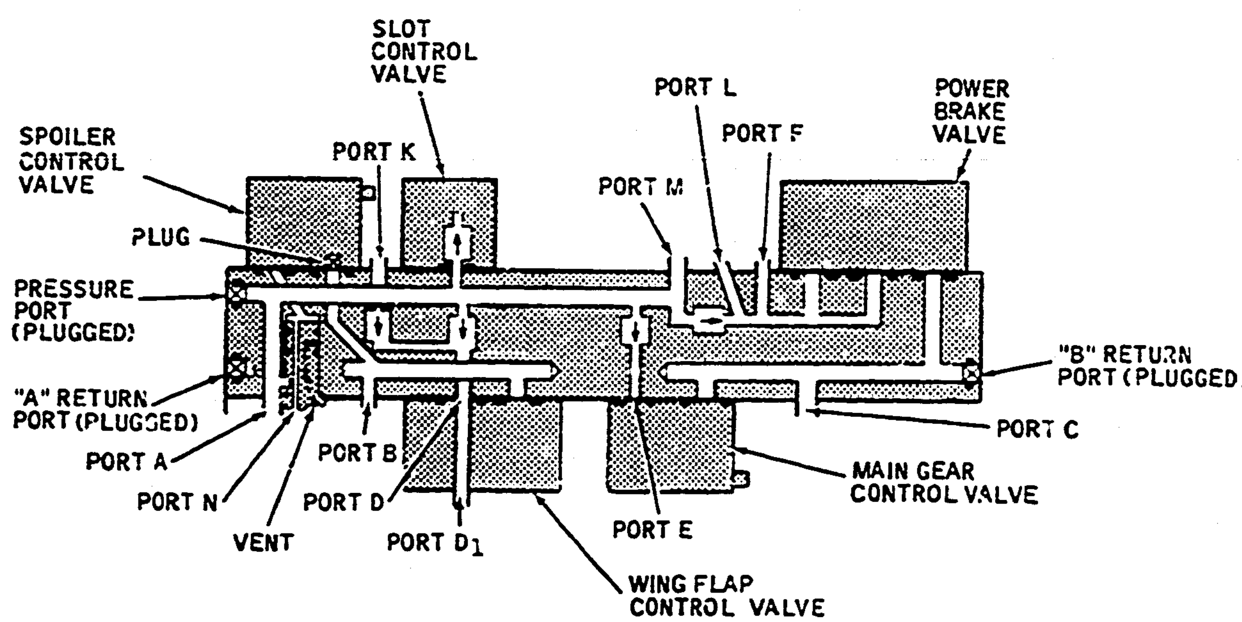
S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.



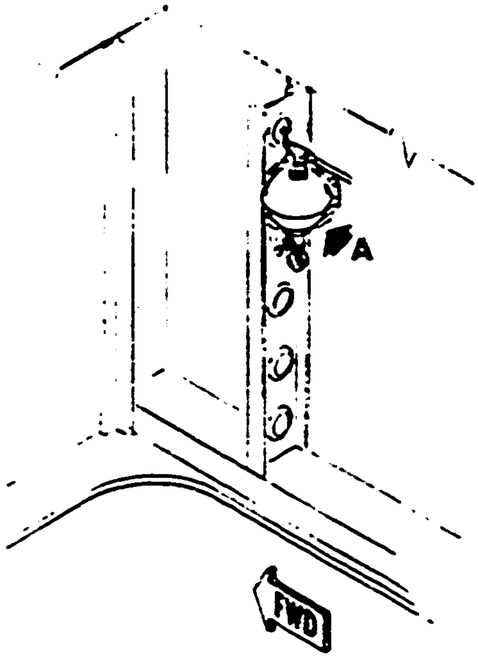


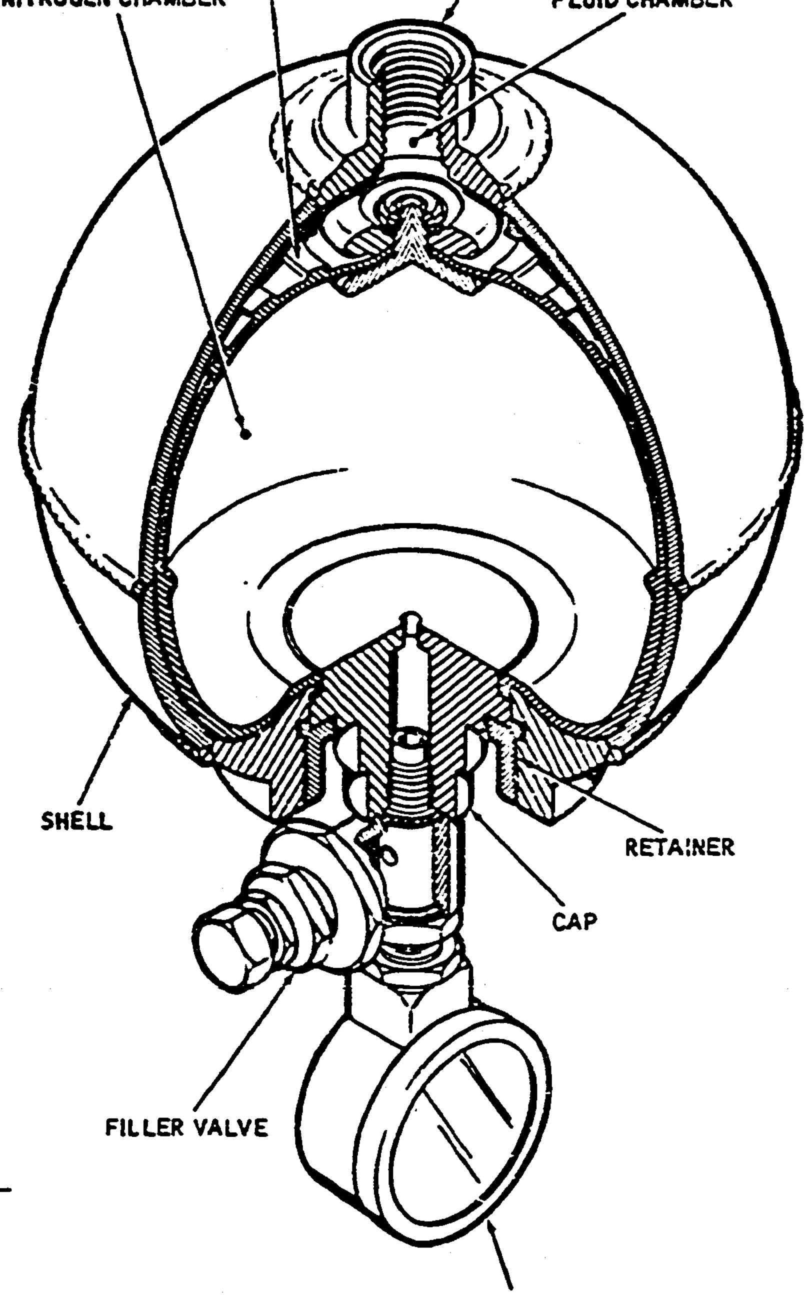
NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.

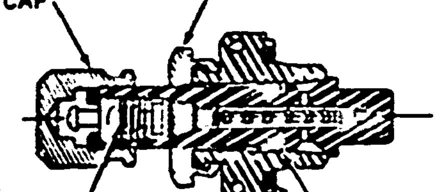


HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19







HA2-30

Hydraulic Power System Accumulator -- Cutaway View
Figure 20

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

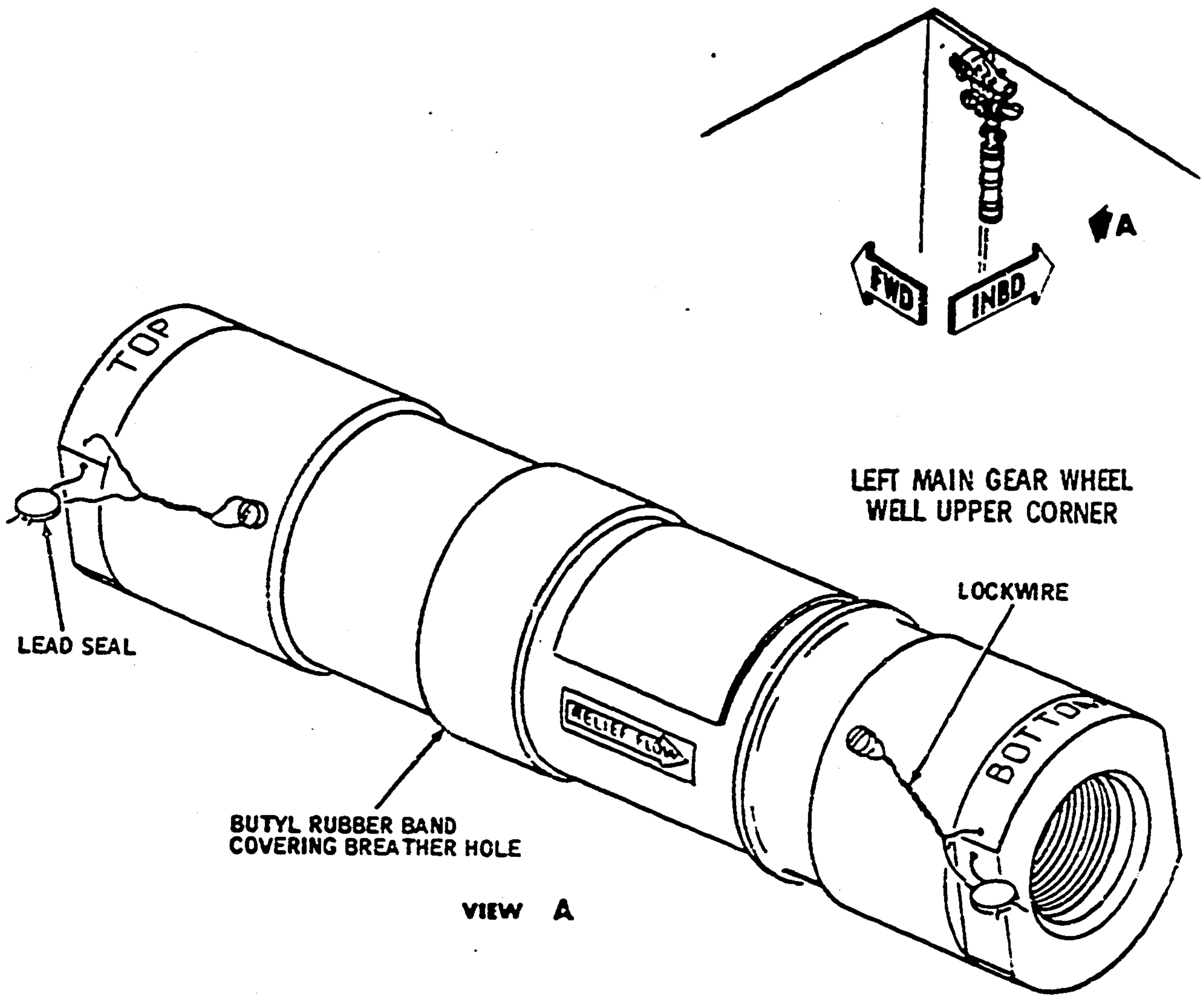
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

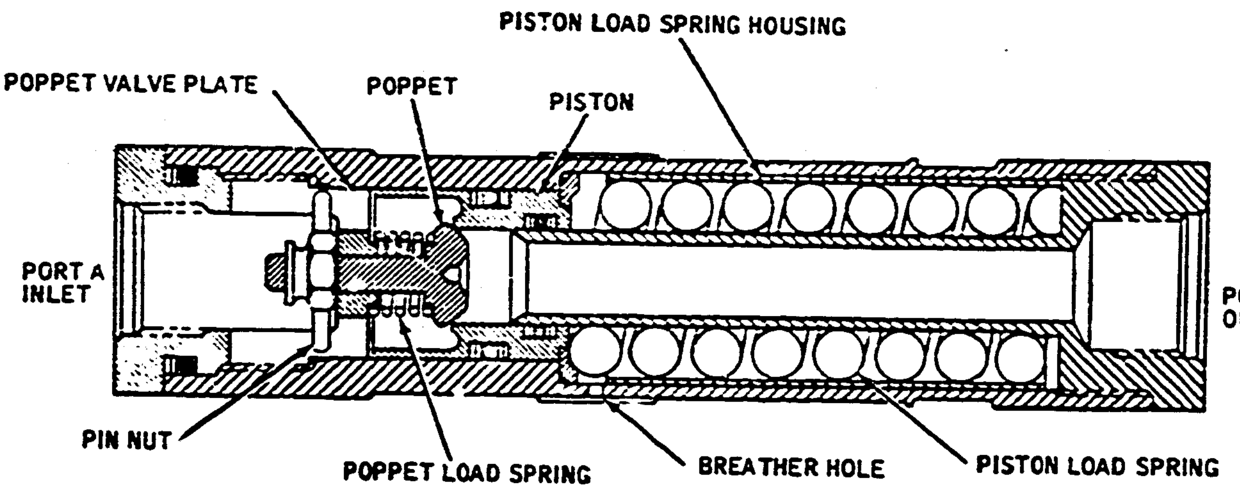
T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.





HA2-856

Hydraulic System Priority Valve -- Cutaway View
Figure 21

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

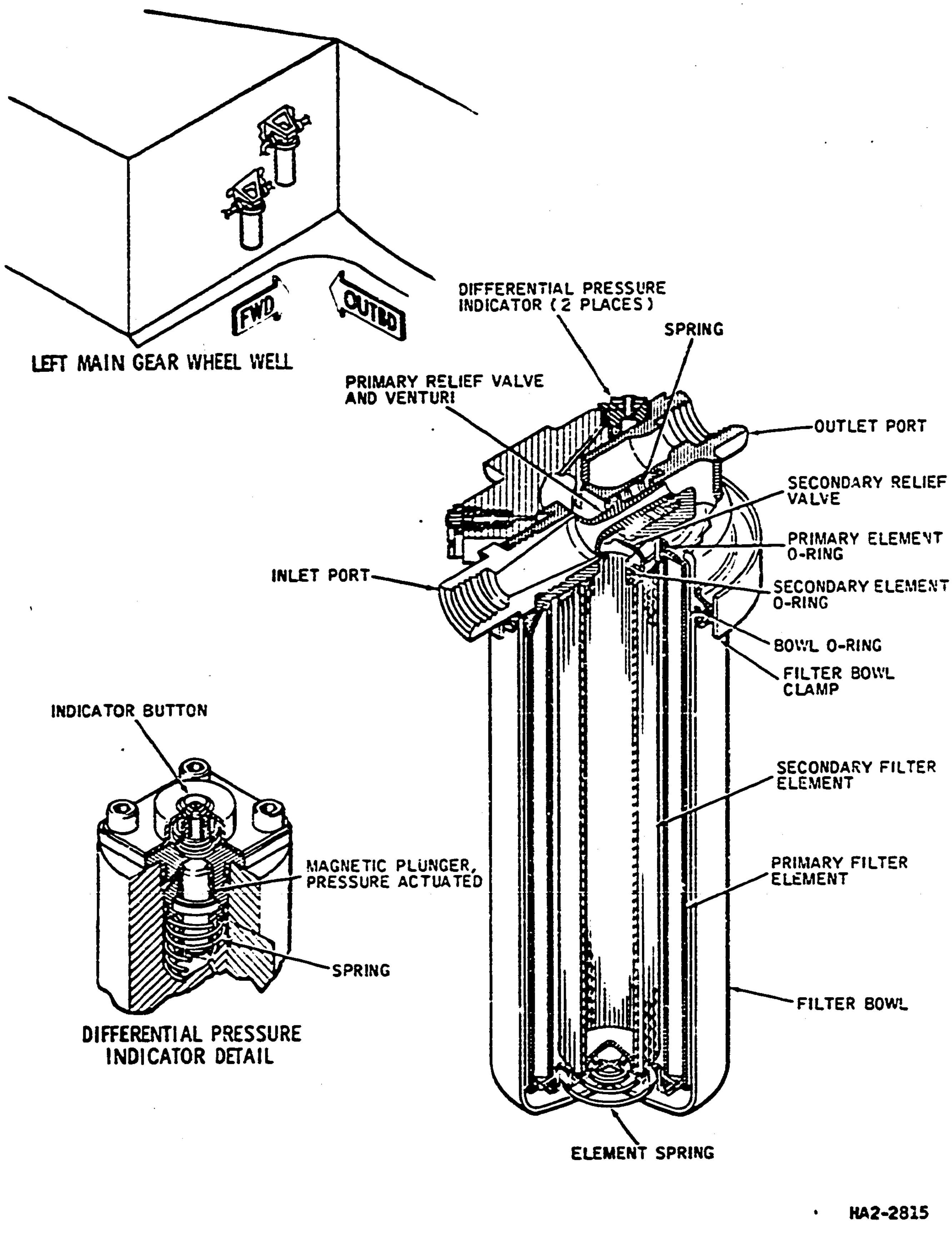
(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Two-Stage Return Filters (See Figure 22.)

(1) The hydraulic system is equipped with two separate two-stage return fluid filters located on the outboard bulkhead of the left main gear wheel well, just aft of the wing rear spar. One filter is connected in the A return line and the other is connected in the B return line, both just upstream of the reservoir return fluid manifold. The filters are rated at 3 microns absolute particle size for the primary stage and 15 microns absolute particle size for the secondary stage. The inlet and outlet ports are internally threaded and are identified in and out. The filter bowl is cylindrical in shape and contains both primary and secondary filter elements in a separable concentric assembly. A spring attached to the bottom of the elements bears against the bottom of the filter bowl to hold the elements in place on shoulders of the filter head. O-ring seals in the upper ends of the filter elements prevent leakage between the shoulders of the filter head and the elements. The bowl is clamped to the filter head immediately below the ports with an O-ring between the bowl and head to prevent external leakage.

(2) Internally, the filters are provided with a relief valve for each stage. The primary stage relief valve consists of a spring loaded poppet with a venturi shaped passage through the poppet. The venturi is designed to allow 5 to 7 gpm of hydraulic fluid to flow through it to the primary



Twc Stage Return Filter -- Cutaway View
Figure 22

stage of the filter. When pressure/flow buildup exceeds the capacity of the venturi, the poppet opens (60 (±9) psi cracking pressure) to allow excess fluid to bypass the primary element. The secondary stage relief valve consists of a pie-tin shaped stainless steel washer located directly above the secondary stage element. Due to the shape and location of the washer in the filter head, a seal is formed between the secondary stage element inlet passage and the outlet port of the filter head. When differential pressure across the secondary element exceeds 350 (±50) psi, the washer deforms to allow excess fluid pressure to bypass the secondary element and flow directly to the outlet port.

(3) Two differential pressure indicators are provided for each two-stage return filter; one for the primary stage element and one for the secondary stage element. The primary stage indicator actuates when the differential pressure across the primary element (due to element contamination) exceeds 44 (±6) psi. The secondary stage indicator actuates when the differential pressure across the secondary element exceeds 100 (±15) psi.

(4) Each indicator consists of a red button which protrudes approximately 3/16 inch when the corresponding filter element becomes overloaded causing a differential pressure across the element. The indicator can be reset by manually depressing the button only after the overloaded condition has been corrected.

(5) A low temperature cutoff device is provided in each indicator. The cutoff device consists of a bimetallic spring which prevents false indication of an overloaded element as caused by high viscosity of the hydraulic fluid at low temperature. Below 32°F (0°C), the spring contracts inward above a shoulder on the indicator button to prevent movement of the button. Above 85 (±15) °F, 29.9 (±9.4) °C, the spring is extended and the indicator button operates normally.

(6) The primary stage element is made of bonded cellulosic aluminum alloy and is of the disposable type. The secondary stage element is made of stainless steel mesh and is of the cleanable type. No provision is made in the filter head to prevent hydraulic fluid loss when the filter bowl and elements are removed for cleaning or replacement.

V. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 35 to 40 psi on airplanes 801-815 and 30 to 35 psi on airplanes 816-822, and 860 and subsequent by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

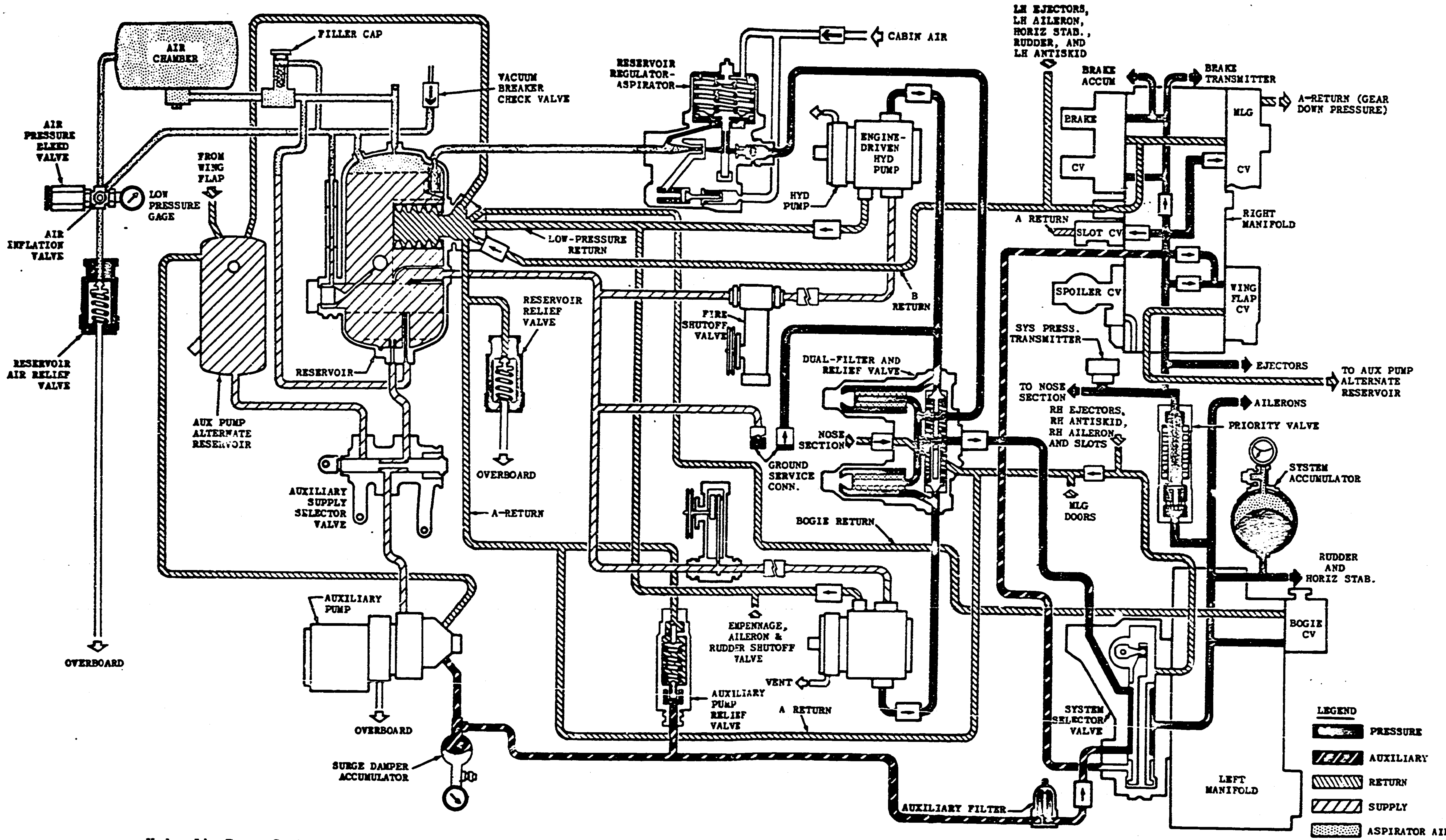
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram
(Airplanes 801-811)
Figure 1 (Sheet 1)

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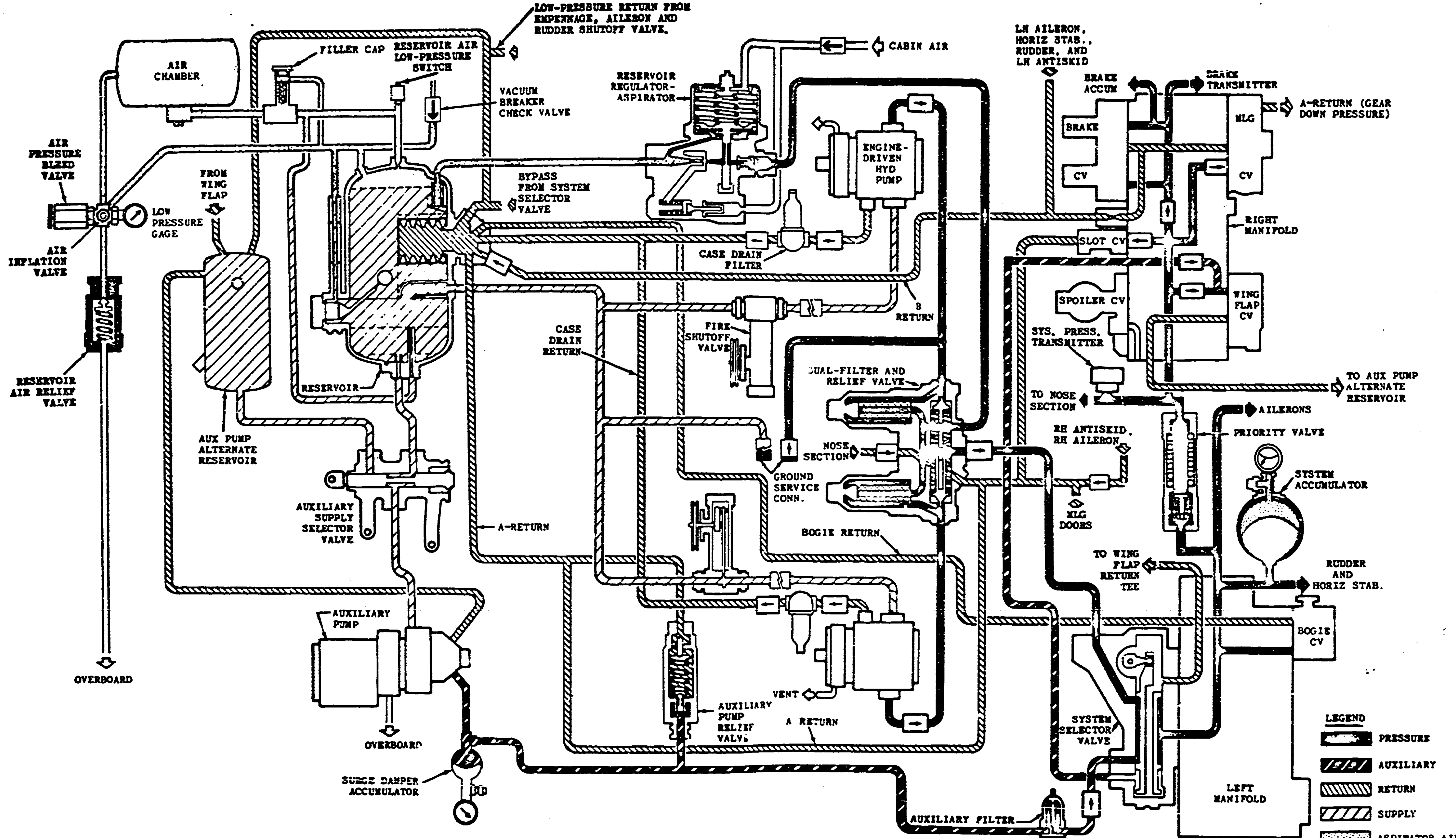
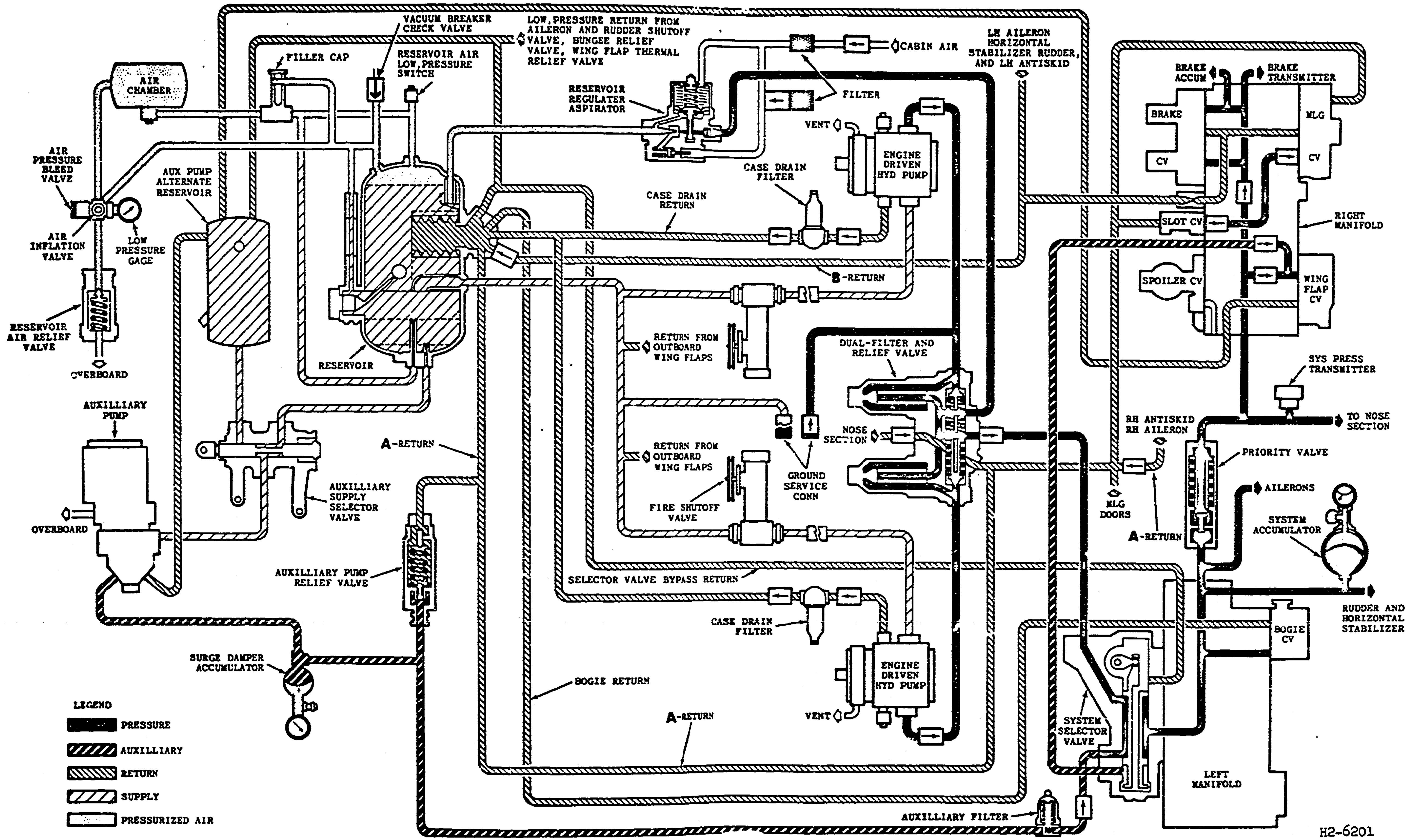
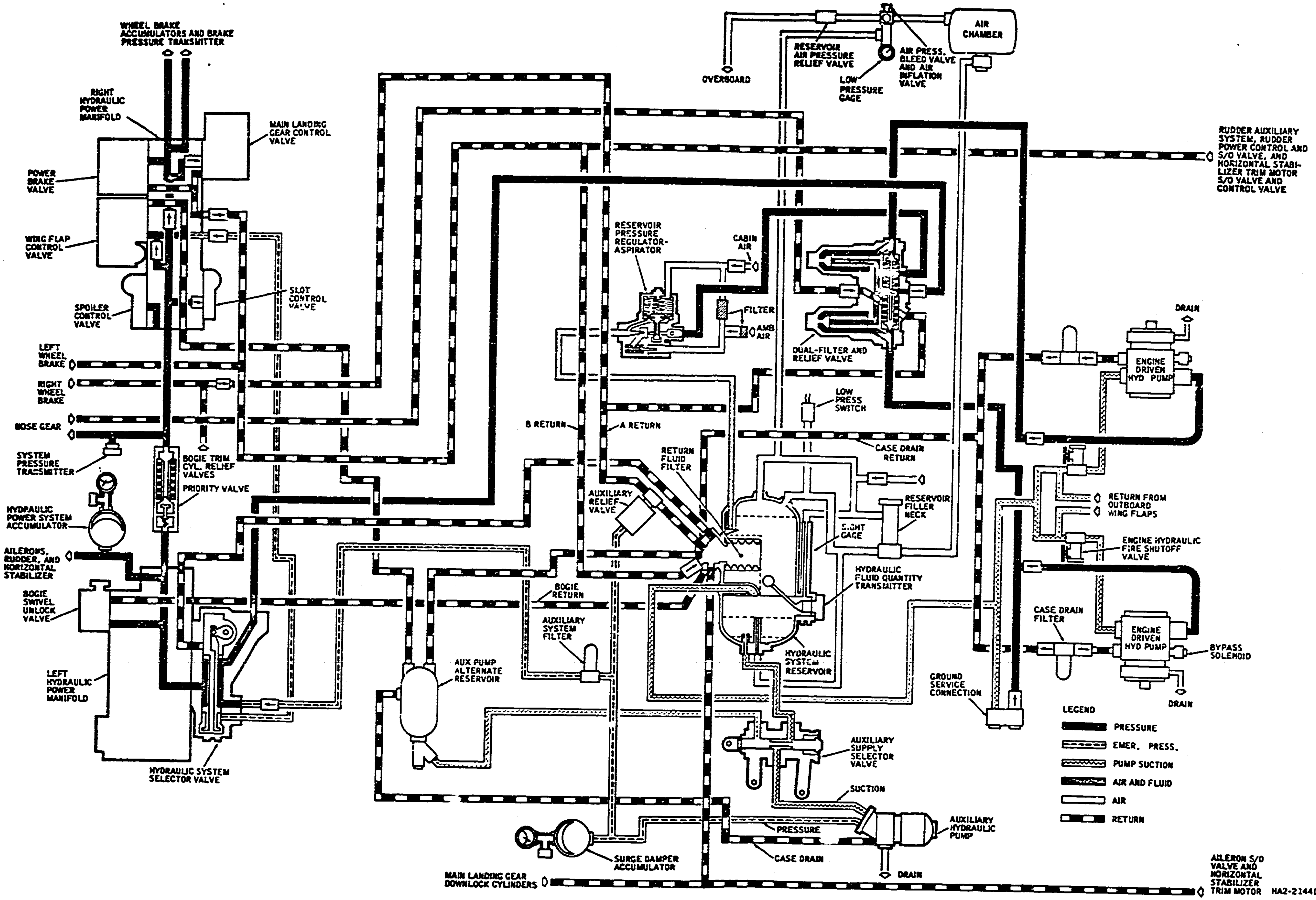


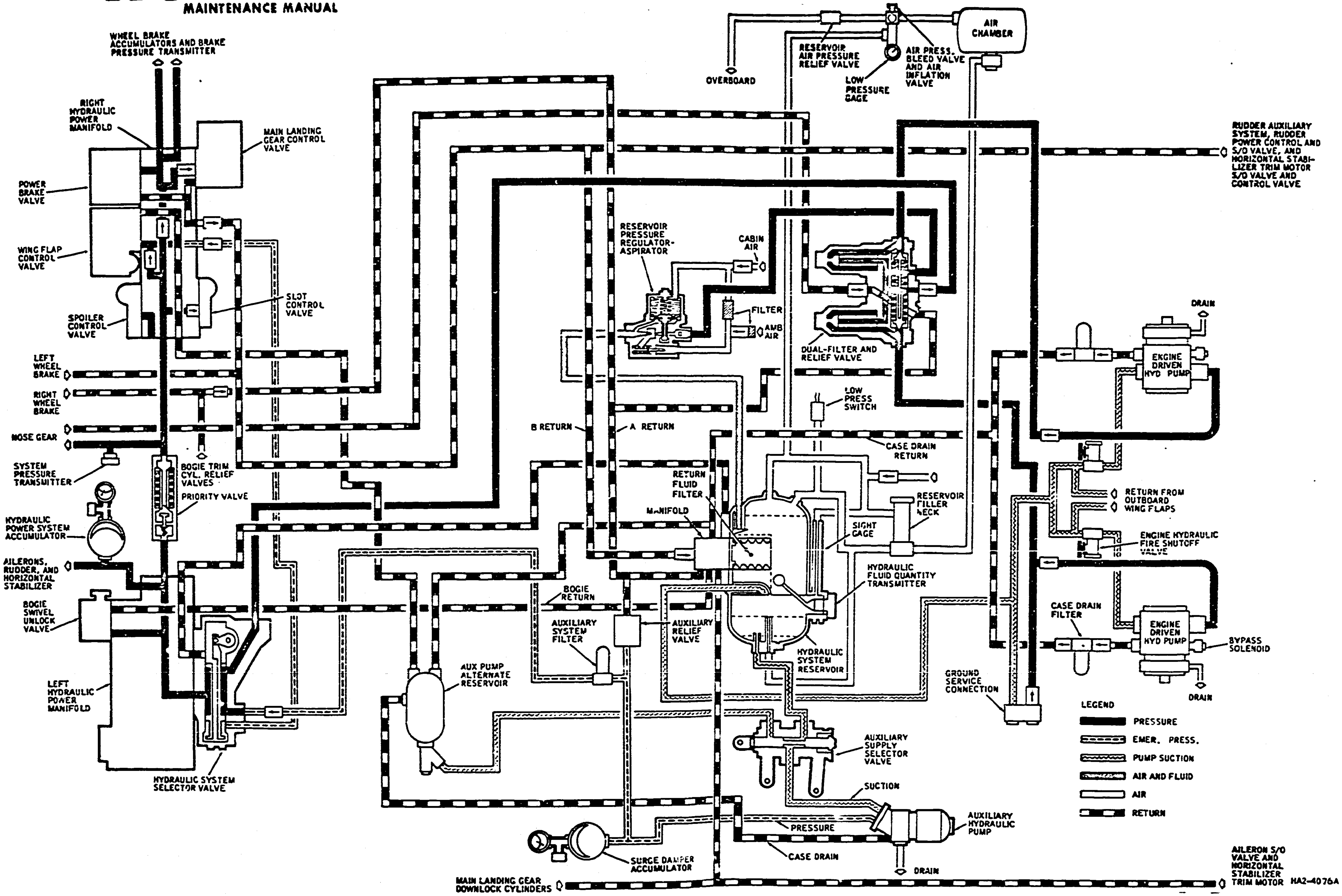
Hydraulic Power System -- Schematic Diagram
(Airplanes 812-815)
Figure 1 (Sheet 2)



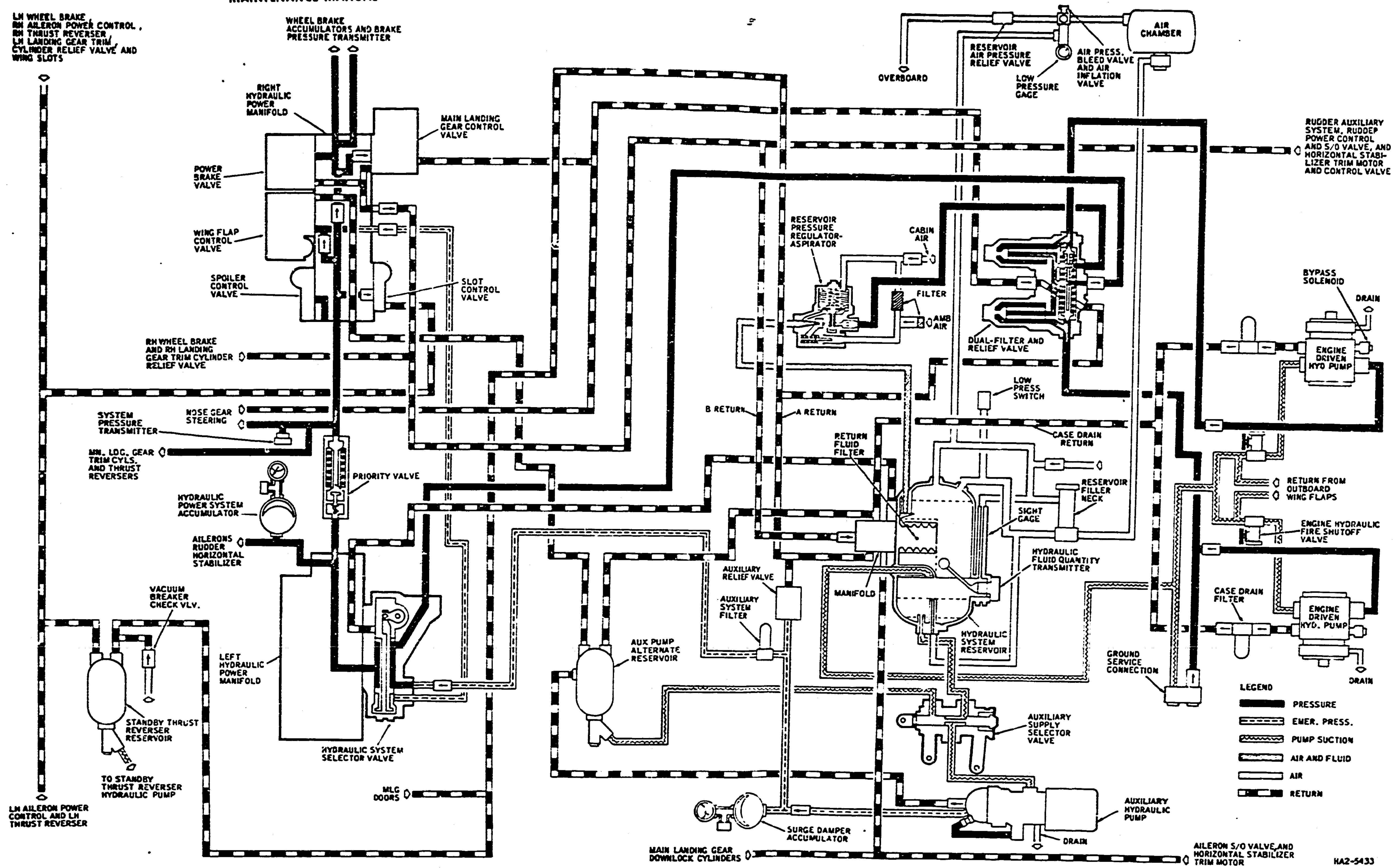
Hydraulic Power System -- Schematic Diagram
(Airplanes 816-822)
Figure 1 (Sheet 3)



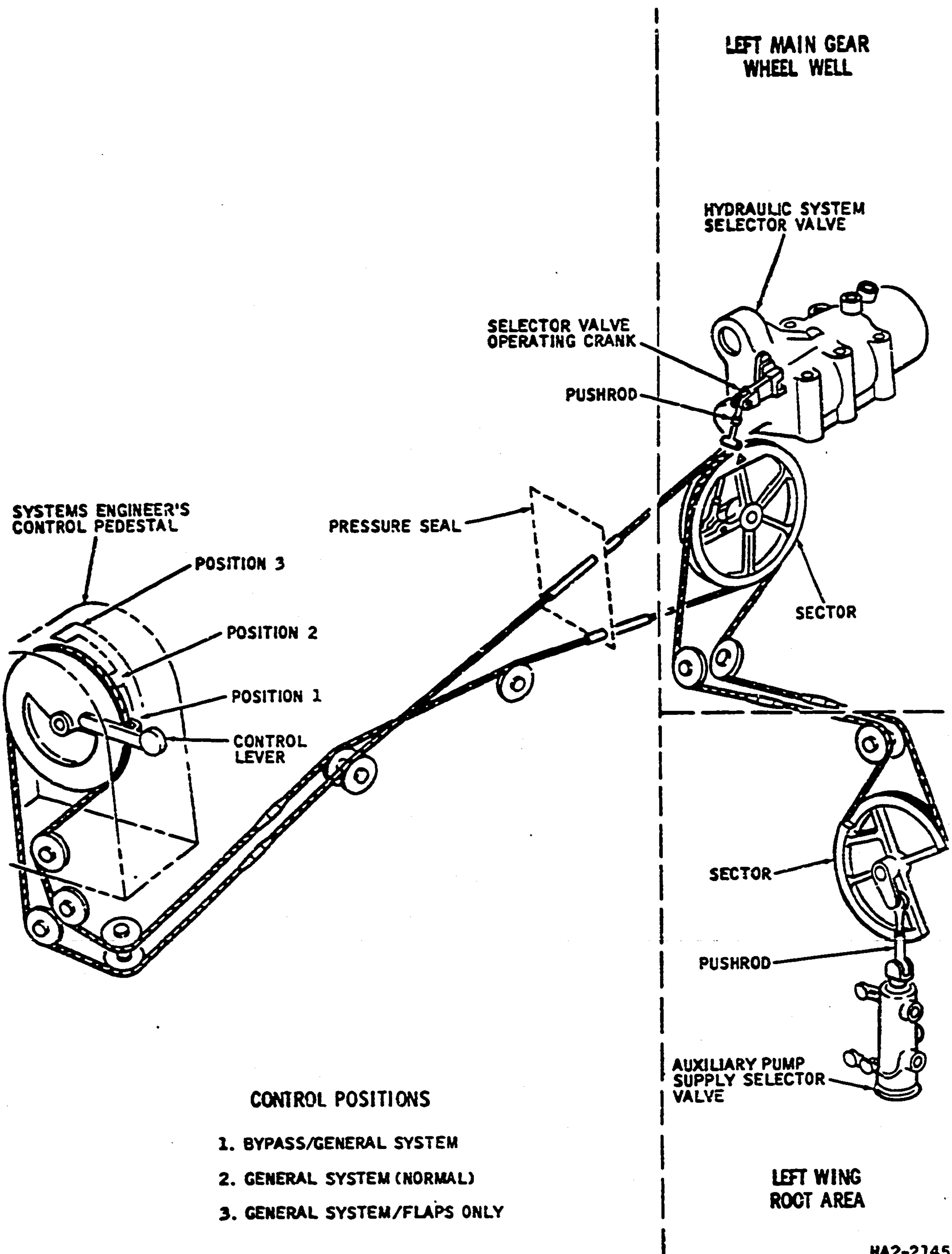
Hydraulic Power System -- Schematic Diagram
(Airplanes 860-863)
Figure 1 (Sheet 4)



Hydraulic Power System -- Schematic Diagram
(Airplanes 864 - 866)
Figure 1 (Sheet 5)



Hydraulic Power System -- Schematic Diagram
(Airplanes 867 and Subs)
Figure 1 (Sheet 6)



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm and the relief valve maintain 35 to 40 psi (airplanes 801-815) or 30 to 35 psi (airplanes 816-822, 860 and subsequent) in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 45 psi (airplanes 801-815) or 40 psi (airplanes 816-822, 860 and subsequent). A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi. On airplanes 801-811, a second relief valve installed in the A return port of the reservoir return ports manifold relieves the reservoir pressure after ejector operation with compressed nitorgen. When the ejectors are subsequently retracted, the nitrogen is returned to the reservoir. The relief valve is set to open at 60 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff

(e) Ejectors (airplanes 801-811)

(6) The right power manifold distribution fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) All return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir on airplanes 801-815. On airplanes 816-822, 860 and subsequent, return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main

reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/flaps only position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet of the system selector valve.

(3) In the general system/flaps only position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector, valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

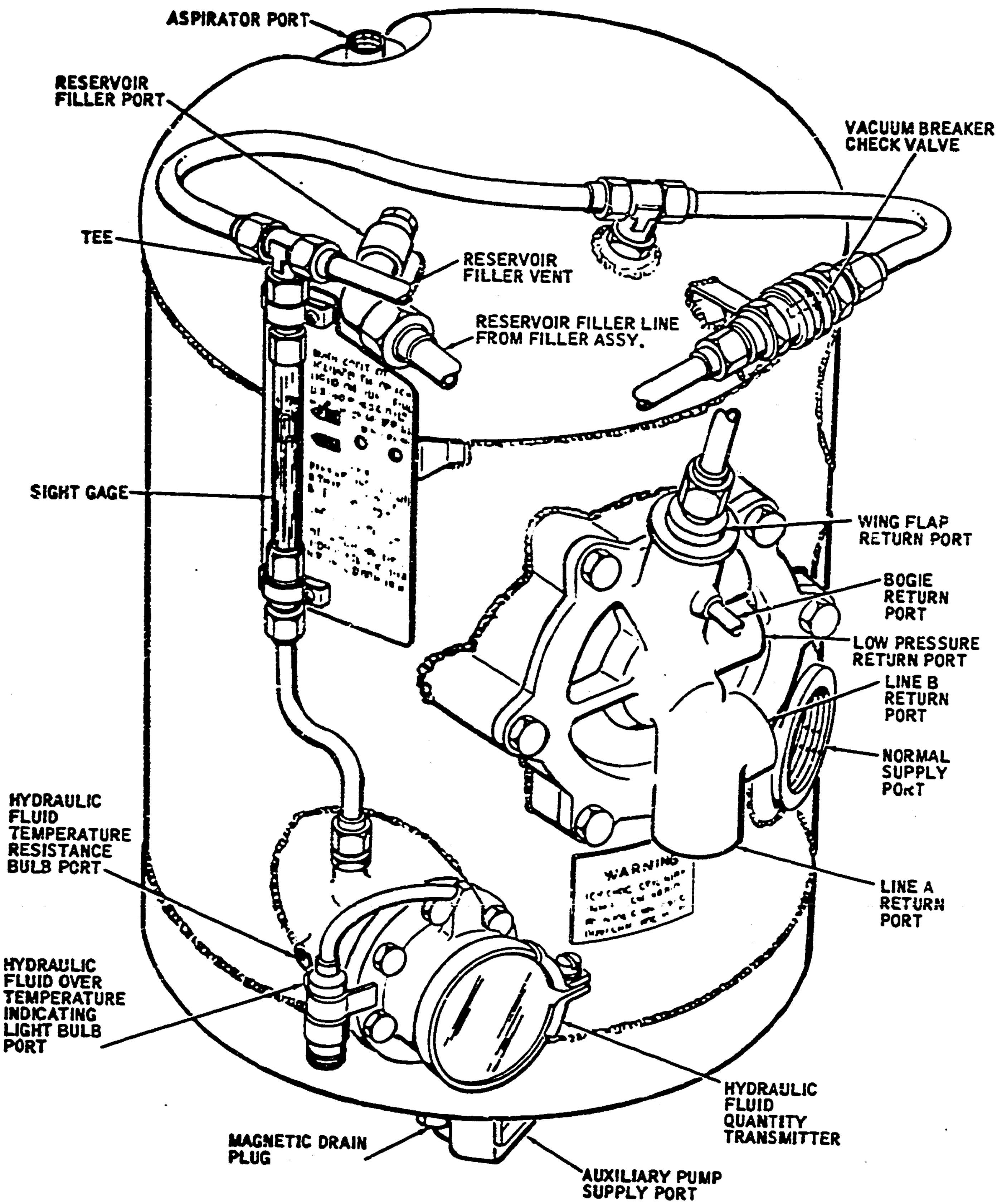
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/flaps only position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve only. Engine-driven pump pressure is ported from the system selector valve to the general system.

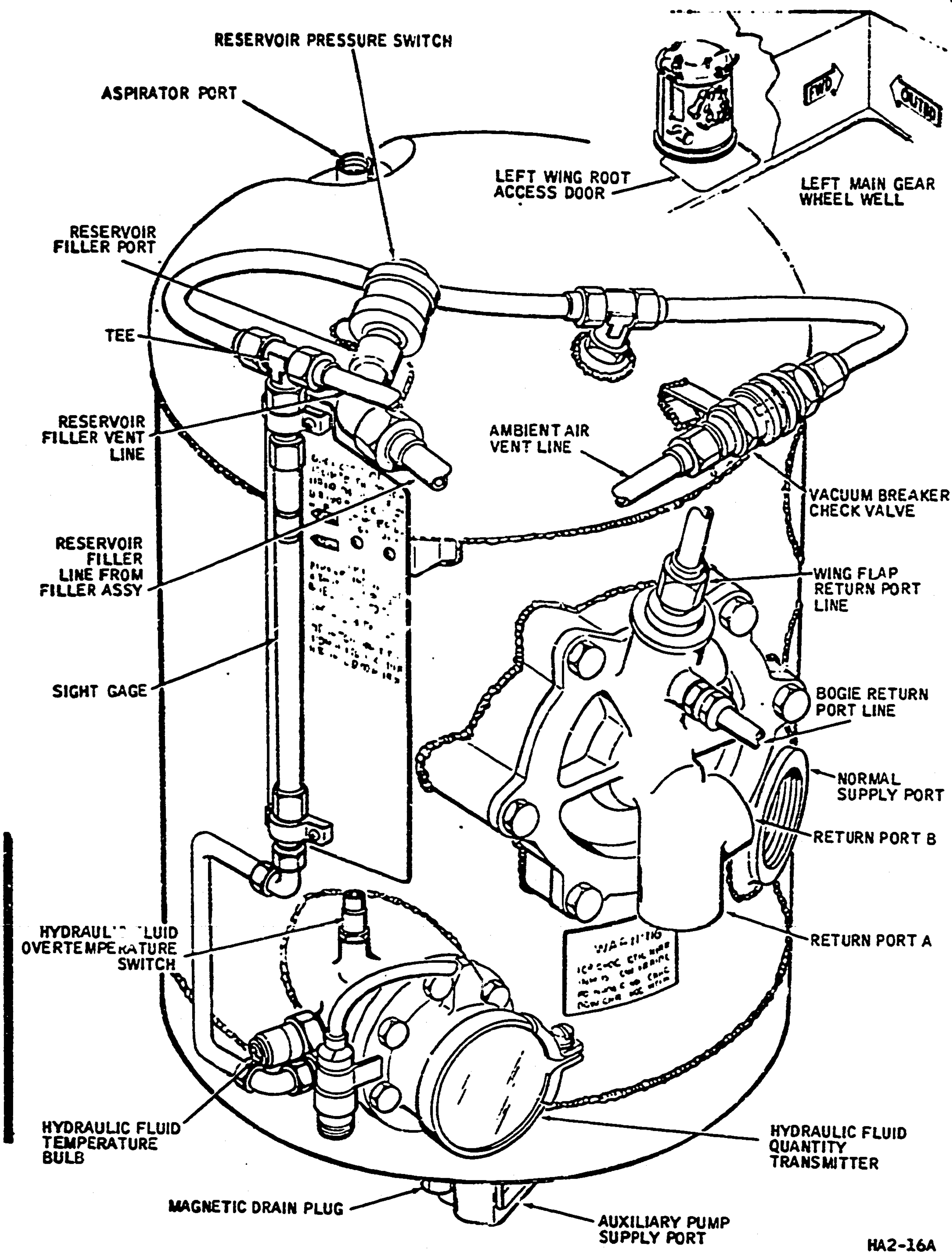
2. System Components

A. Hydraulic System Reservoir (Airplanes 801-822, 860-863, See Figures 3 and 4.)

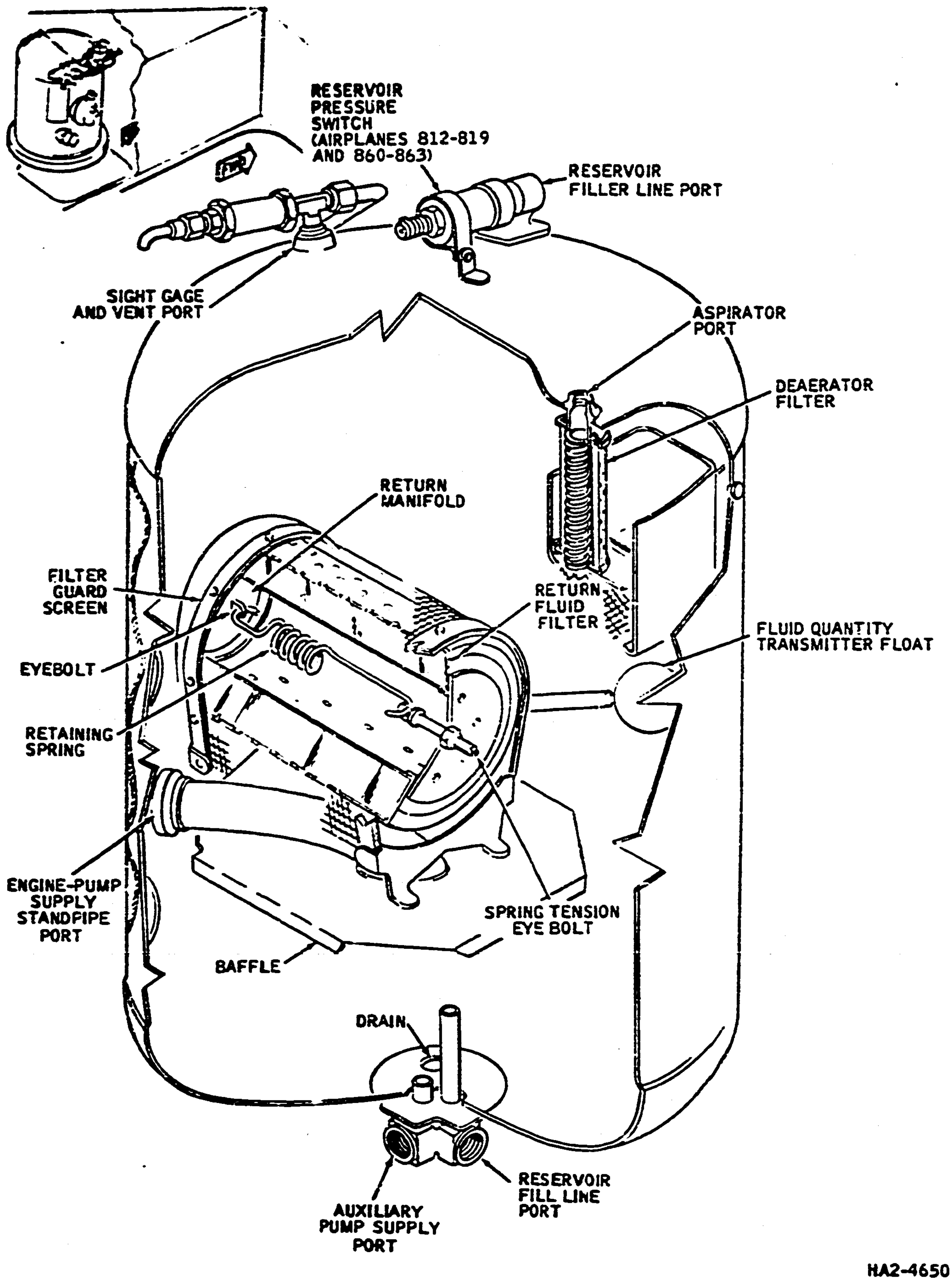
(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports,



Hydraulic System Reservoir -- External View
(Airplanes 801-811)
Figure 3 (Sheet 1)



Hydraulic System Reservoir -- External View
(Airplanes 812-822, 860-863)
Figure 3 (Sheet 2)



Hydraulic System Reservoir -- Cutaway View
(Airplanes 801-822, 860-863)
Figure 4

aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to between 35 and 40 psi on airplanes 801-815, and 30 and 35 psi on airplanes 816-822, 860 and subsequent, and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

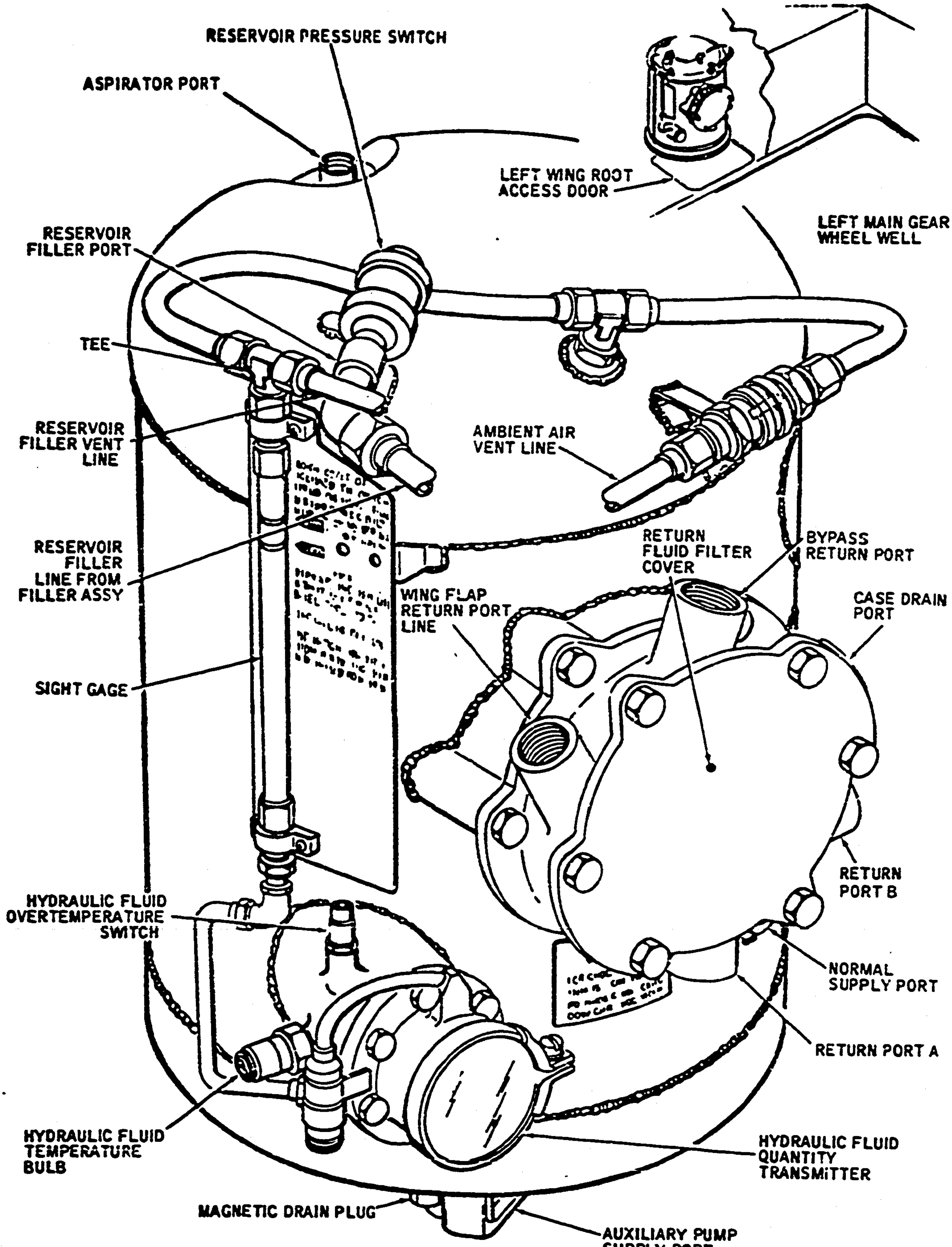
(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The manifold is bolted to the flange and contains five ports: return port A, located at the bottom; return port B, located at the lower right side; the low-pressure return port, located at the upper right; the wing flap return port, located at the top; and the bogie return port, located on the face of the manifold just below the wing flap return port.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the manifold holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

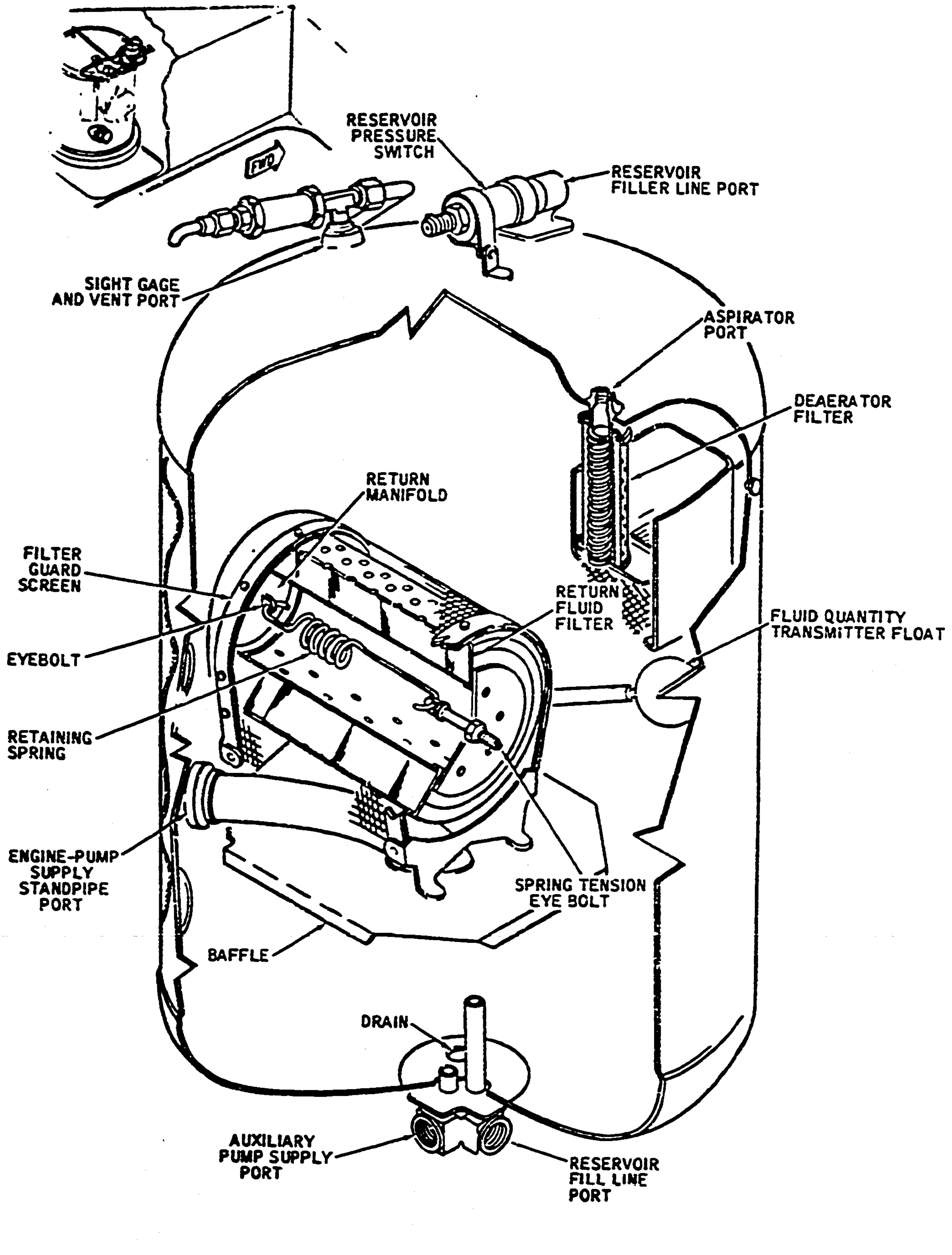
(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic System Reservoir (Airplanes 864 and Subsequent, See Figures 5 and 6.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign



Hydraulic System Reservoir -- External View
(Airplanes 864 and Subsequent)
Figure 5



Hydraulic System Reservoir -- Cutaway View
(Airplanes 864 and Subsequent)
Figure 6

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particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to between 30 and 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

C. Hydraulic Reservoir Return Fluid Filter (Airplanes 801-822, 860-863, See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contamining the fluid supply. The filter is located behind the return ports manifold and is spring loaded

to act as its own relief valve. Access to the filter is by removing the return ports manifold. Removal of the return ports manifold necessitates disconnecting the return lines from the manifold and removal of six bolts which secure the manifold to the reservoir. The filter which is attached to the manifold is then withdrawn from the reservoir.

(2) Externally, the filter consists of two perforated, concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return ports manifold. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own reflief valve and unseats at 10 to 20 psi above normal return pressure on airplanes 801-811 and 20 to 25 psi above normal return pressure on airplanes 812-822 and 860-863. When the relief valve unseats fluid is allowed to bypass the filter and enter the reservoir.

D. Hydraulic Reservoir Return Fluid Filter (Airplanes 864 and Subsequent, See Figure 6.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by a retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining

spring. One end of the spring is attached to an eyebolt located inside the return ports manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

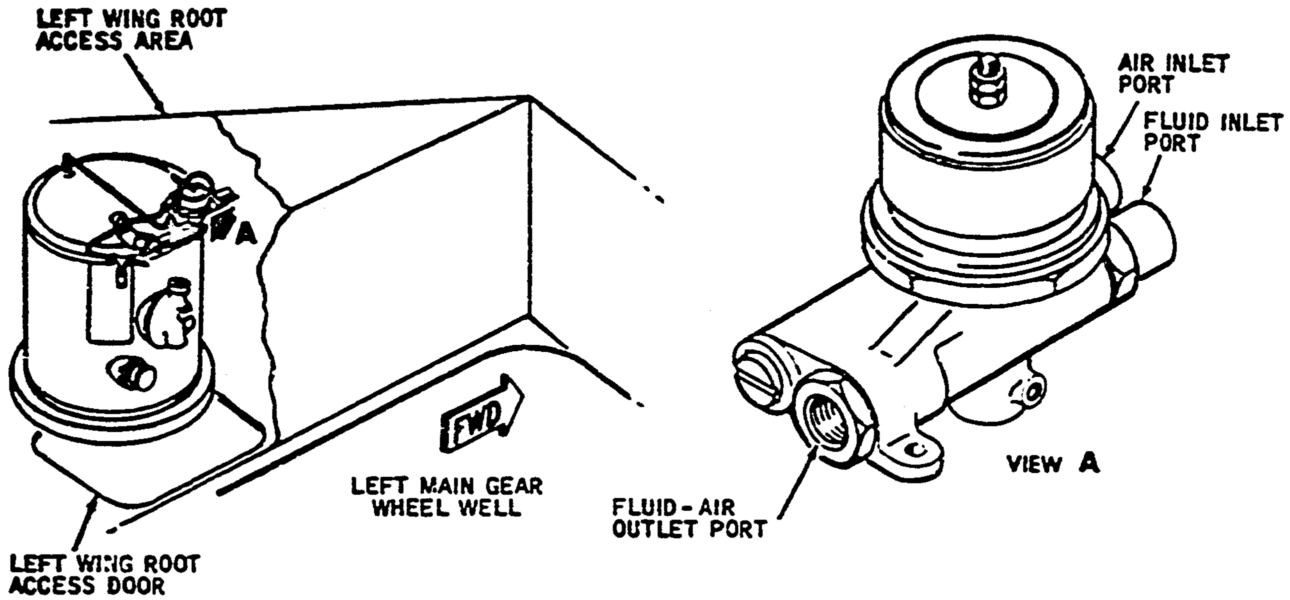
E. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 7)

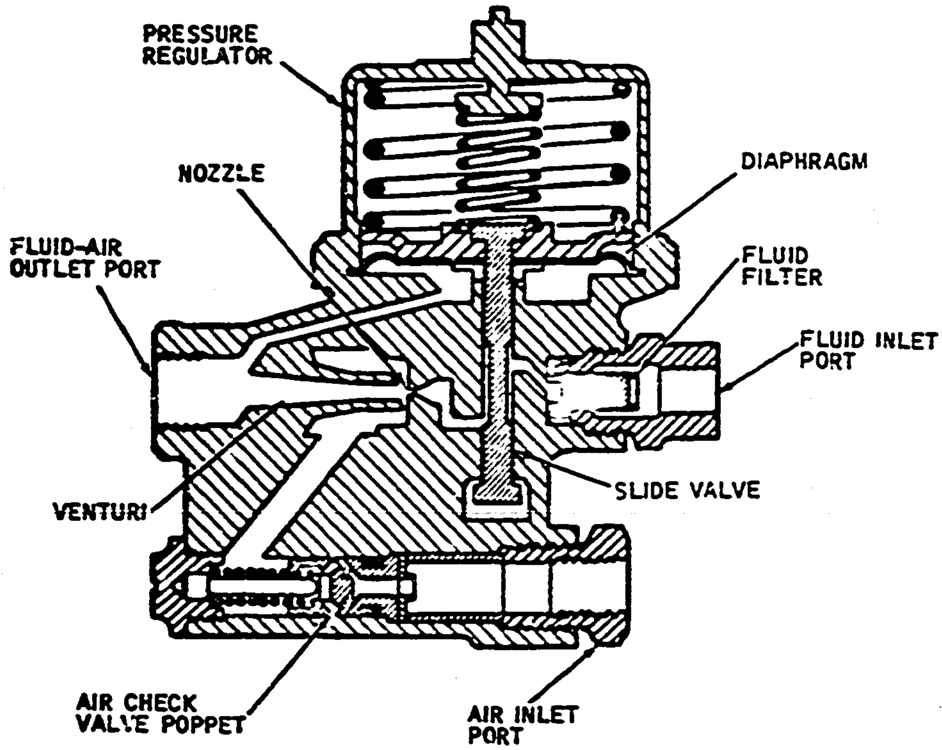
(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure of 35 to 40 psi on airplanes 801-815 and 30 to 35 psi on airplanes 815-822, 860 and subsequent. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to the regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently stamped inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. On airplanes 816-822, 860 and subsequent, a chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. When air pressure at the outlet port is under 35 psi on airplanes 801-815 or 30 psi on airplanes 816-822, 860 and subsequent, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

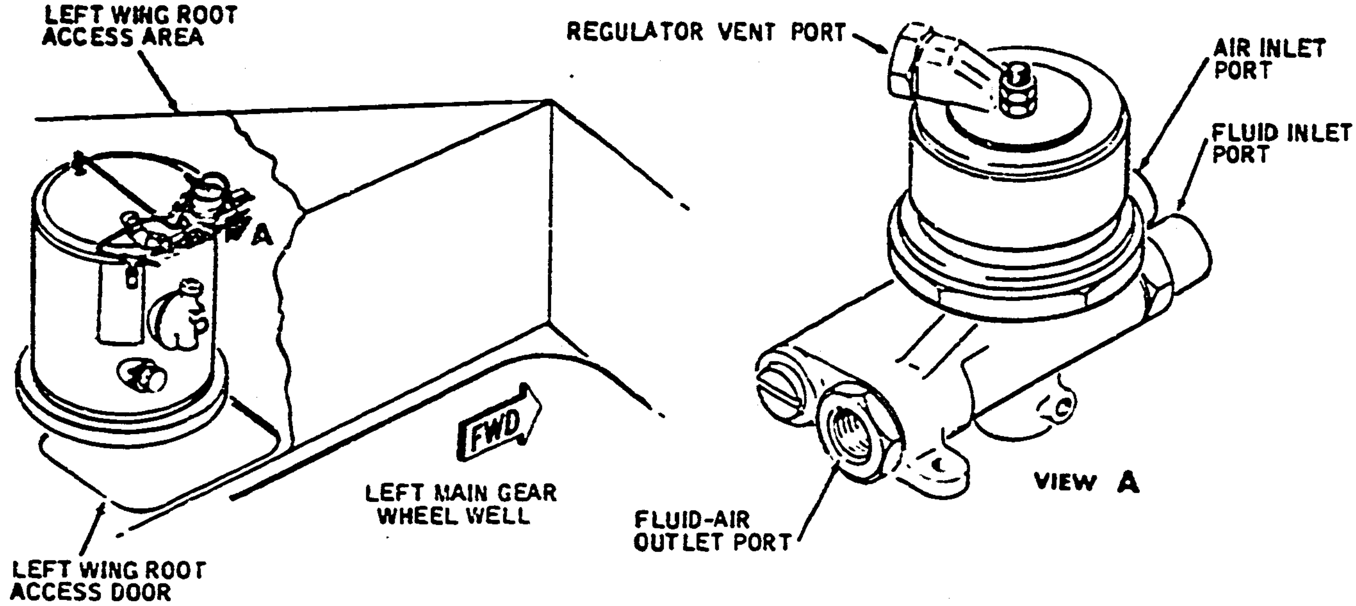
(4) On airplanes 816-822, 860 and subsequent, hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir

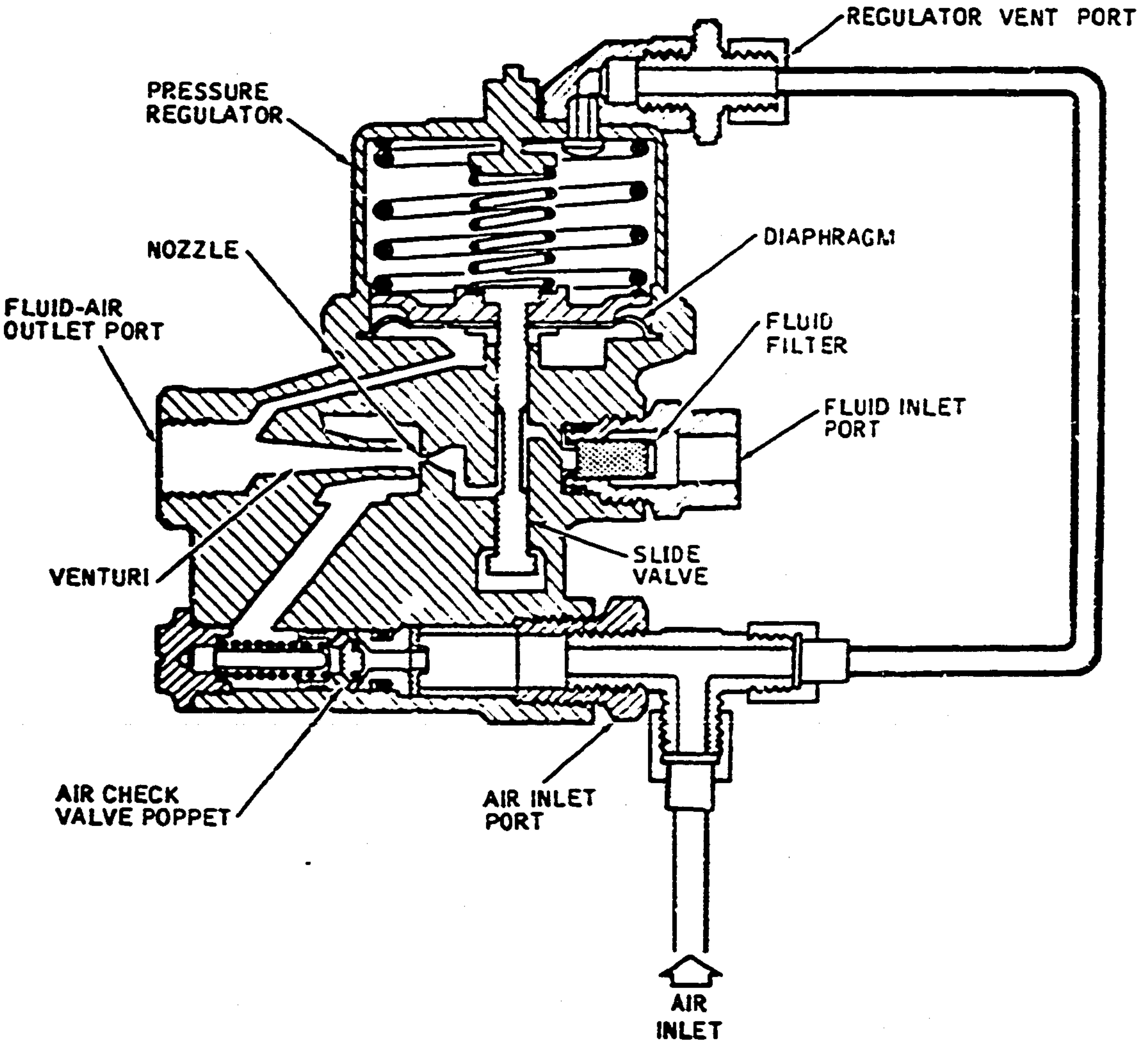




HA2-4651

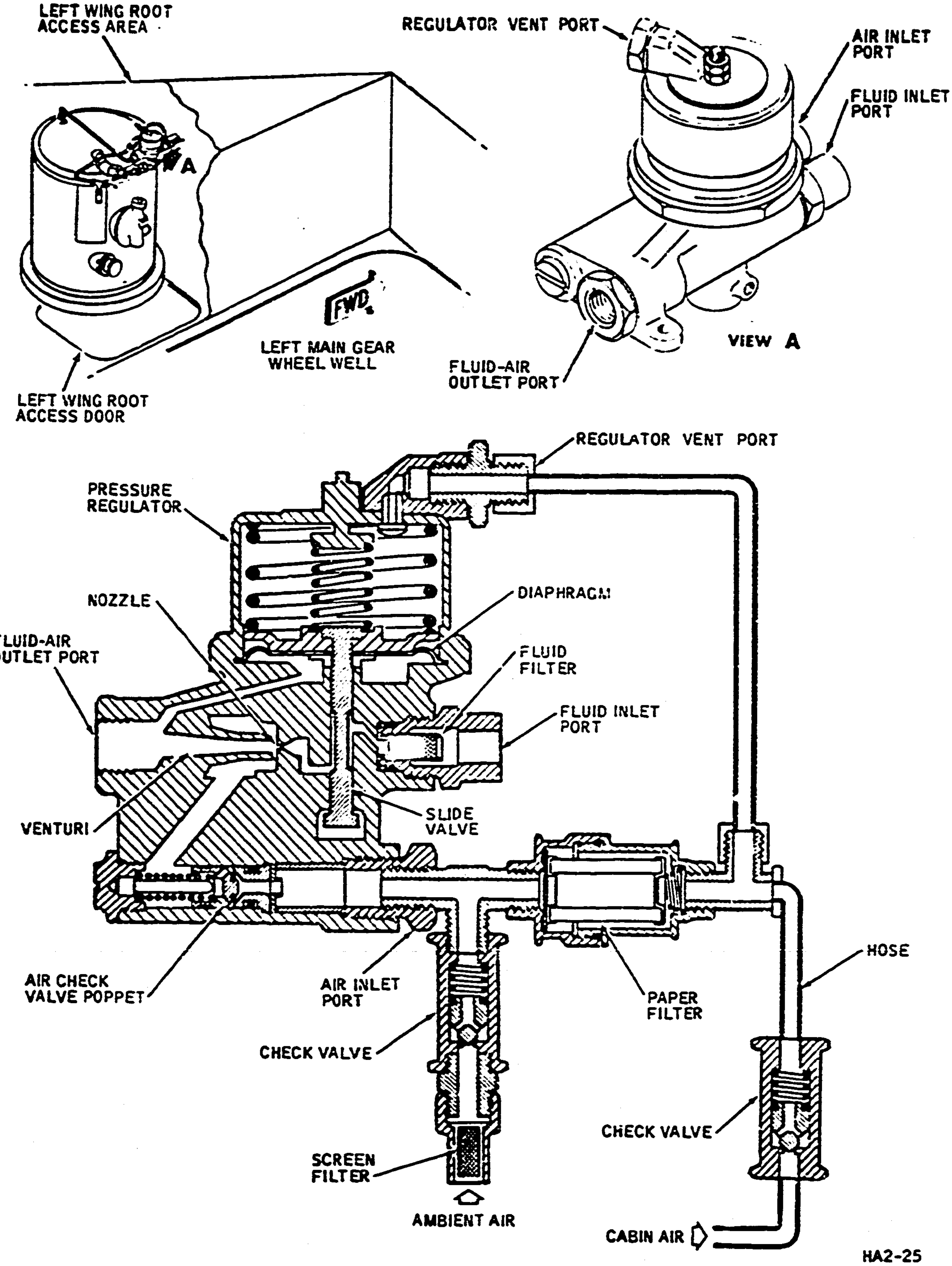
Reservoir Air Pressure Regulator-Aspirator -- Schematic
(Airplanes 801-810)
Figure 7 (Sheet 1)





HA2-4652

Reservoir Air Pressure Regulator-Aspirator -- Schematic
(Airplanes 811-815)
Figure 7 (Sheet 2)



Reservoir Air Pressure Regulator-Aspirator -- Schematic
(Airplanes 816-822, 860 and Subsequent)
Figure 7 (Sheet 3)

regulator-aspirator instead of ambient outside air. On airplanes 801-810, the aspirator and the regulator diaphragm are vented to ambient air. On airplanes 811-822, 860 and subsequent, part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. Airplanes 816-822, 860 and subsequent are equipped with two inlet air filters; a chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air; a steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 35 to 40 psi (airplanes 801-815) or 30 to 35 psi (airplanes 816-822, 860 and subsequent) the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

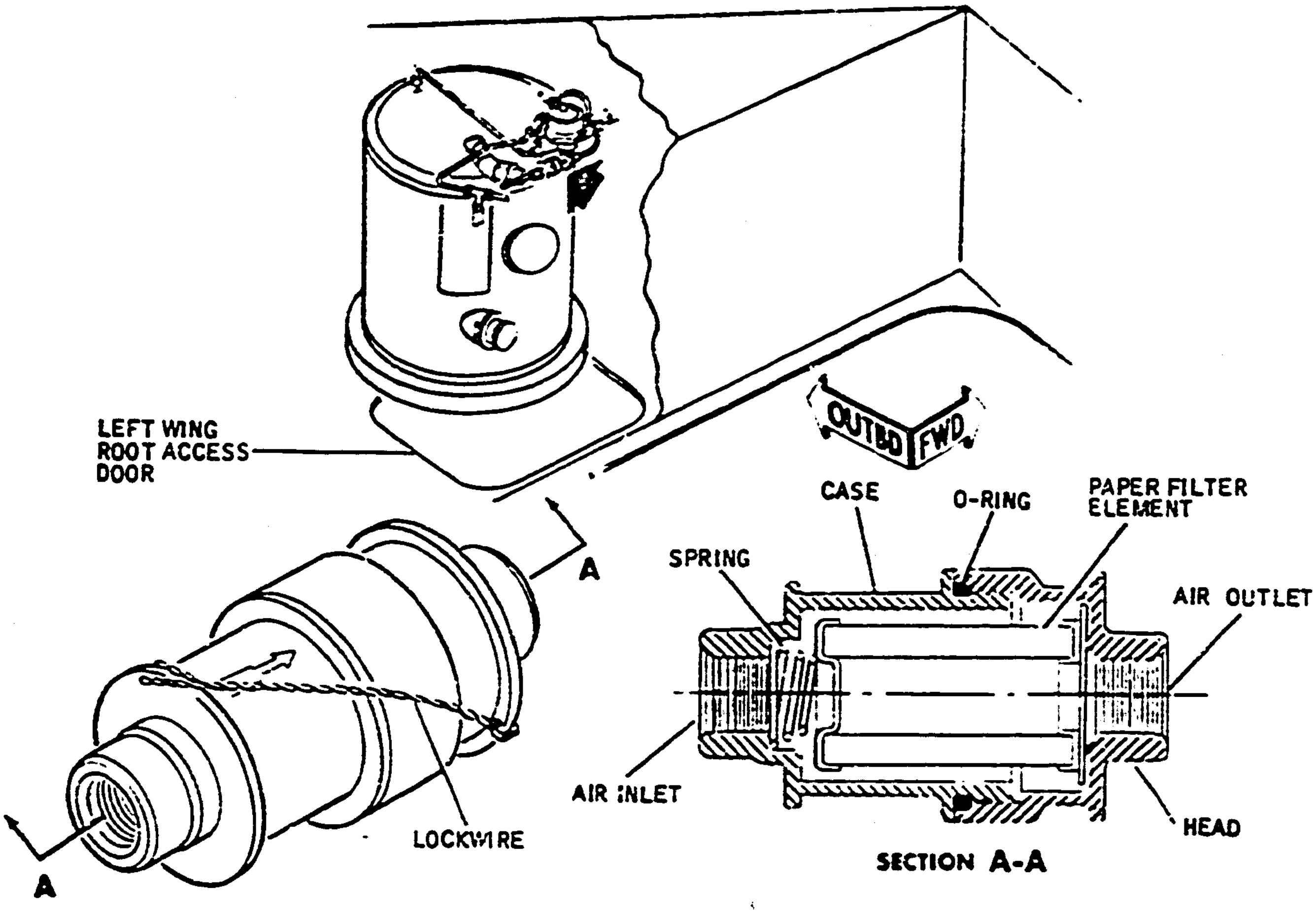
(6) The aspirator is capable of pressurizing the reservoir to 35 to 40 psi on airplanes 801-815 or to 30 to 35 psi on airplanes 816-822, 860 and subsequent in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

F. Regulator-Aspirator Air Filters (See Figure 8.)

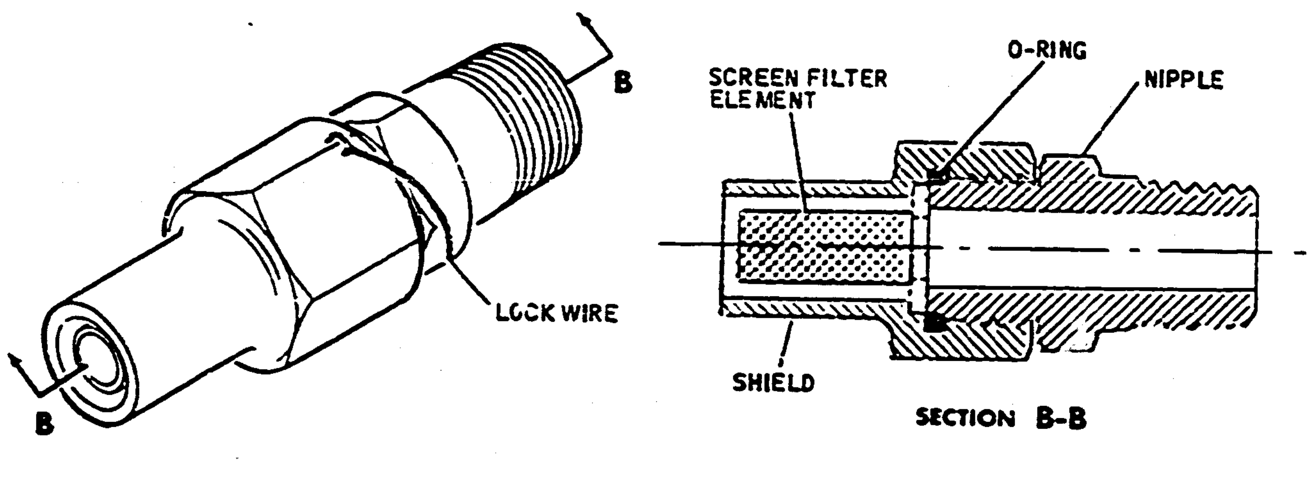
(1) The regulator-aspirator air filters, installed in airplanes 816-822, 860 and subsequent remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

G. Hydraulic Reservoir Relief Valve (See Figure 9.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.



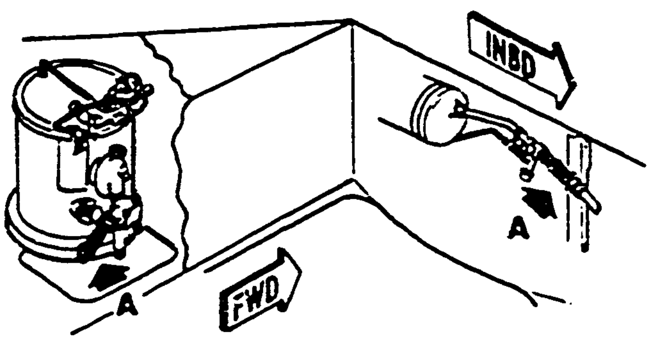
PAPER ELEMENT FILTER



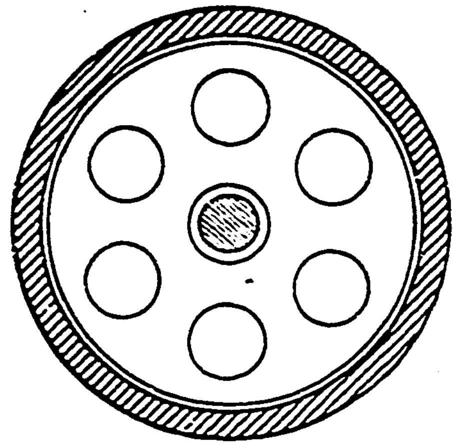
SCREEN FILTER

HA2-35

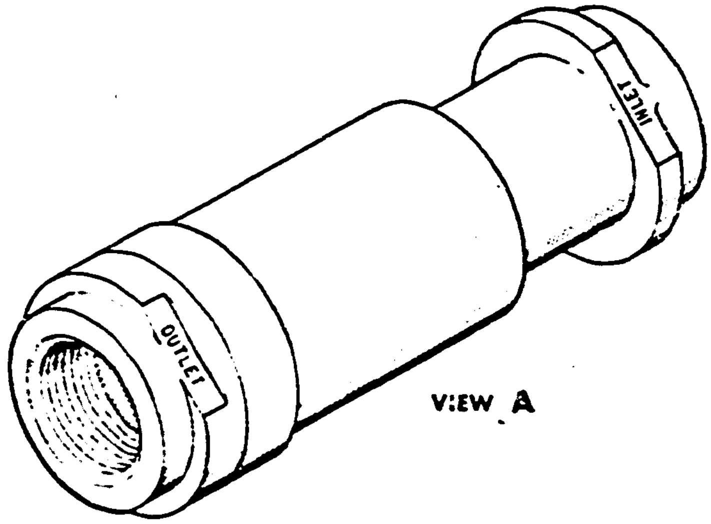
Regulator-Aspirator Air Filters --
Cutaway View
Figure 8



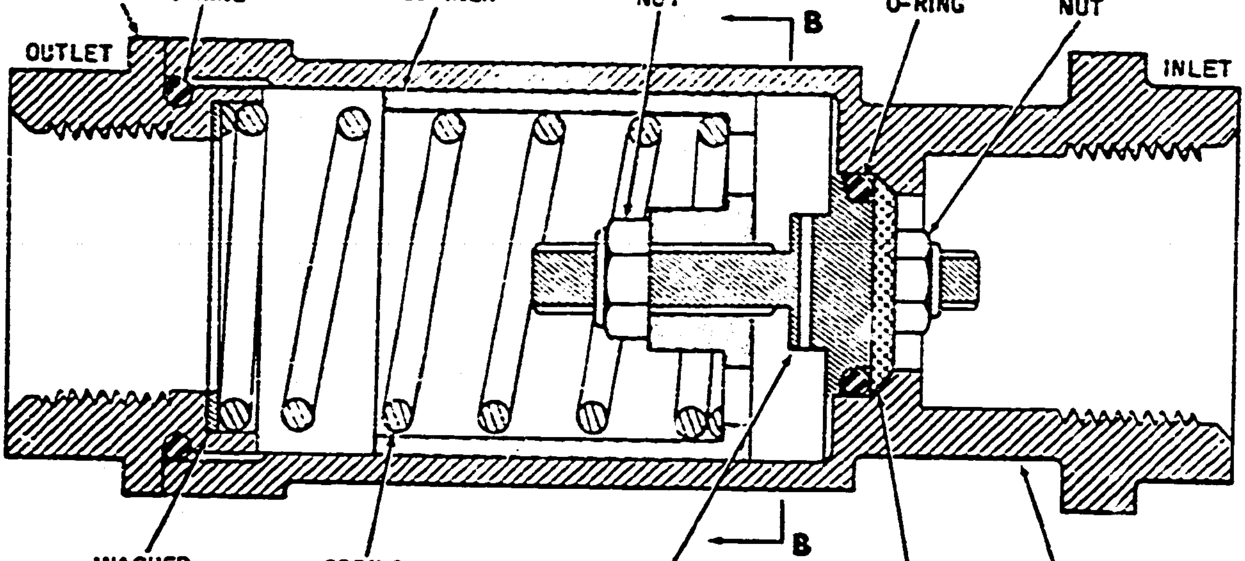
LEFT MAIN GEAR
WHEEL WELL



SECTION B-B



VIEW A



HA2-4654

Hydraulic Reservoir Relief Valves
Figure 9

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

(3) Airplanes 801-811 are equipped with a second reservoir relief valve to relieve excess nitrogen pressures resulting from the operation of the engine ejectors. The second relief valve is connected to the A return port of the reservoir return ports manifold. The valve is set to start to relieve at 60 (+5, -0) psi. Full flow of 7 gpm is attained at 80 psi (maximum) and the poppet will reseat at 90 percent of opening pressure.

H. Hydraulic Reservoir Air Bleed Valve (See Figure 10.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

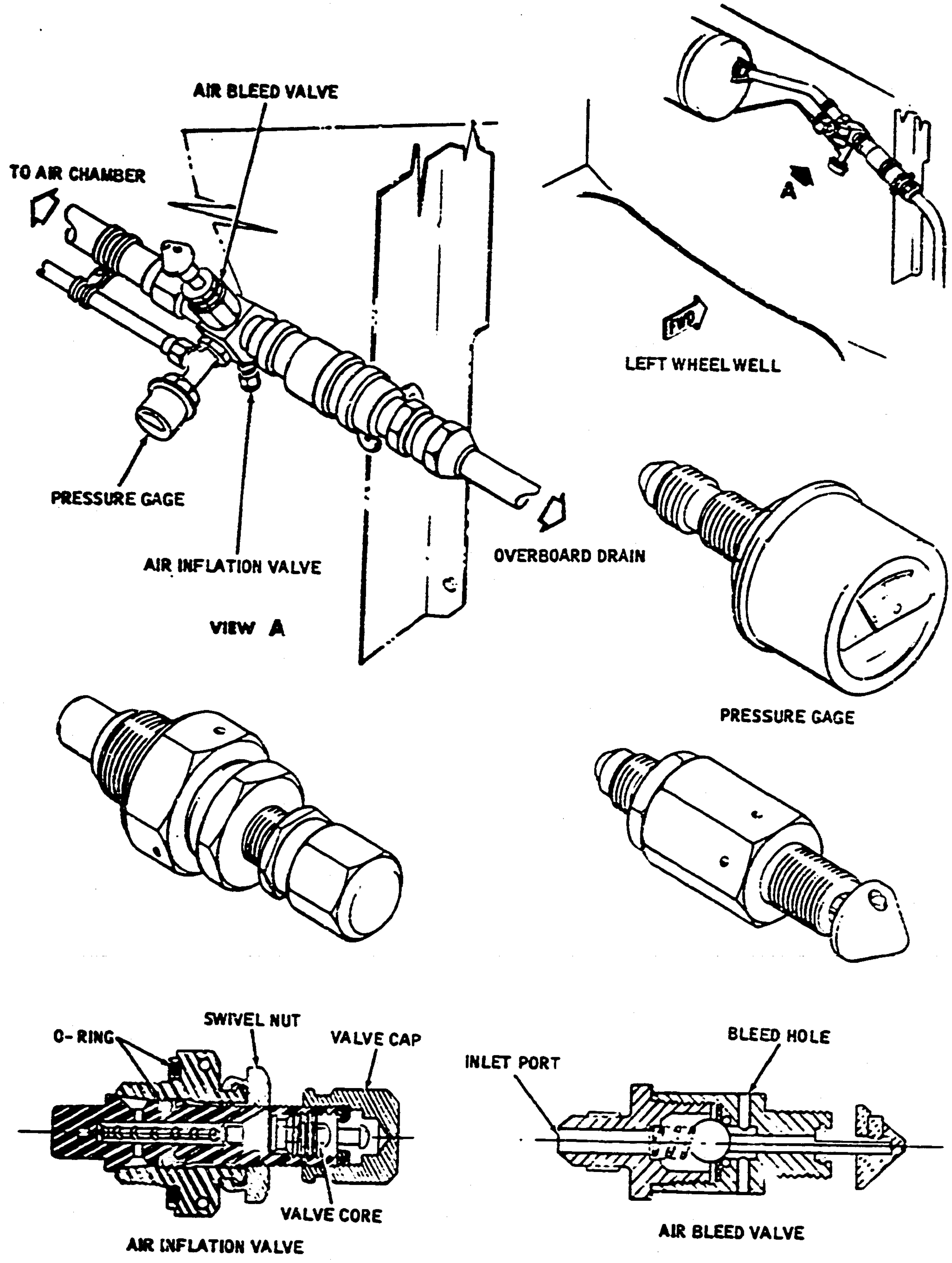
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

I. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 11.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

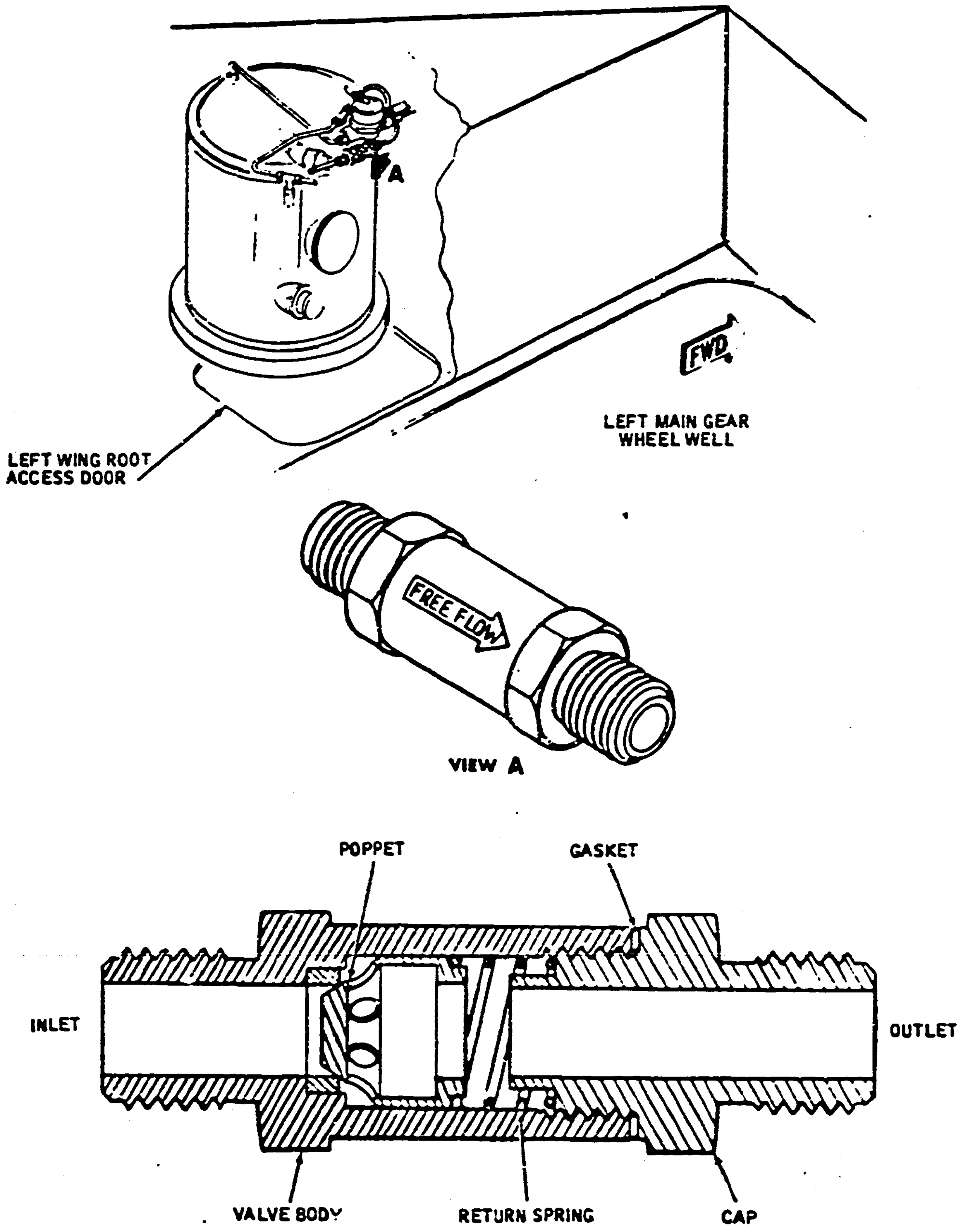
J. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.



HA2-32

Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage
Figure 10



HA2-33

Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 11

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

K. Hydraulic Reservoir Port B Return Check Valve (See Figure 12.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500 psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

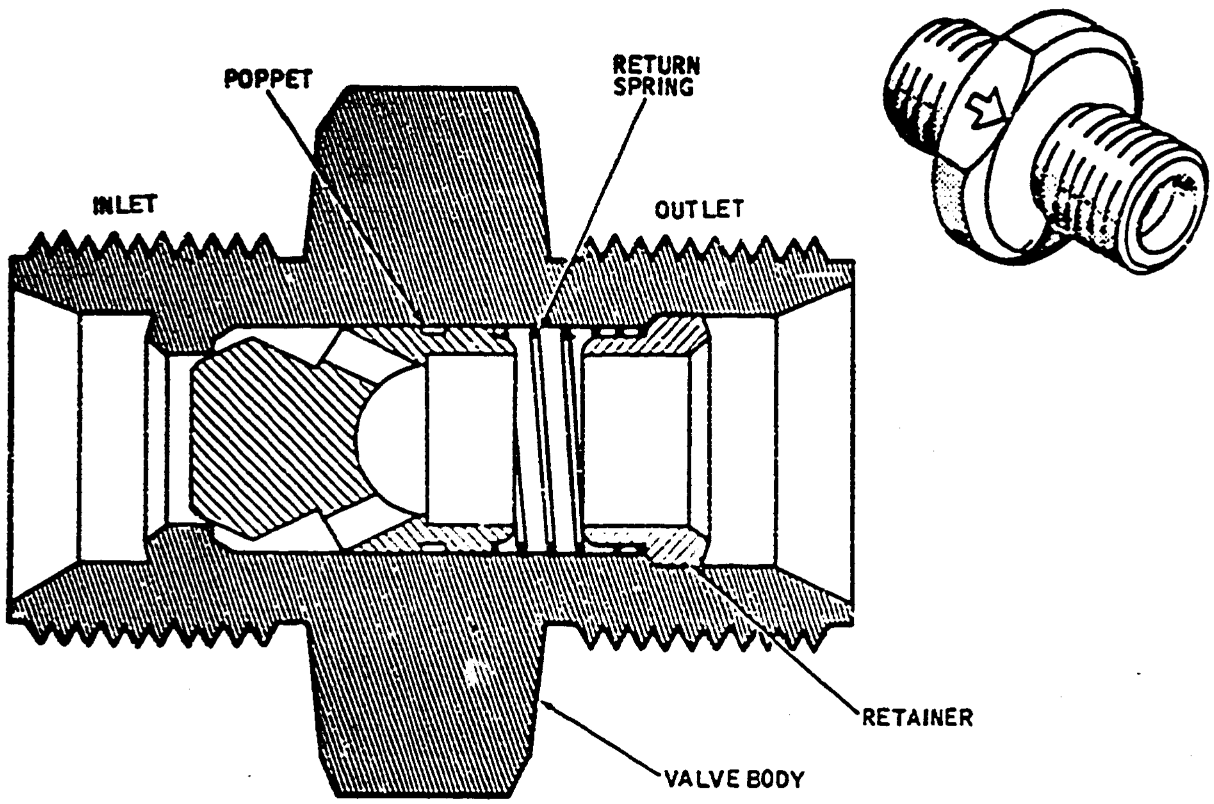
L. Engine Hydraulic Fire Shutoff Valve (See Figures 13 and 14.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

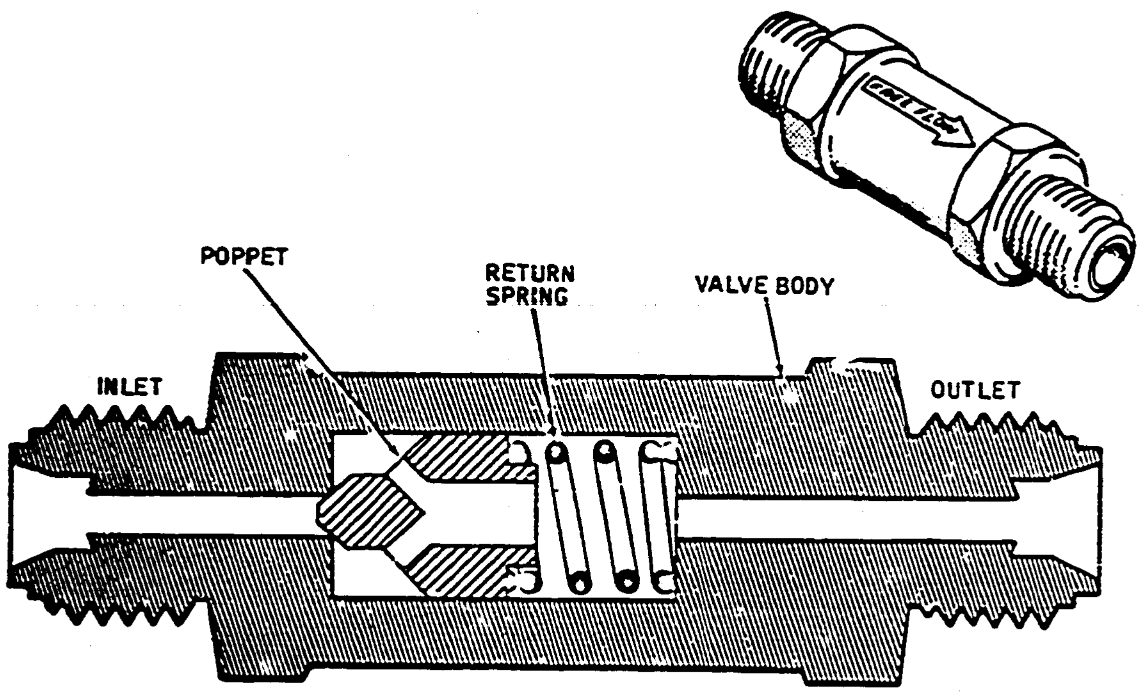
(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cap plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 12

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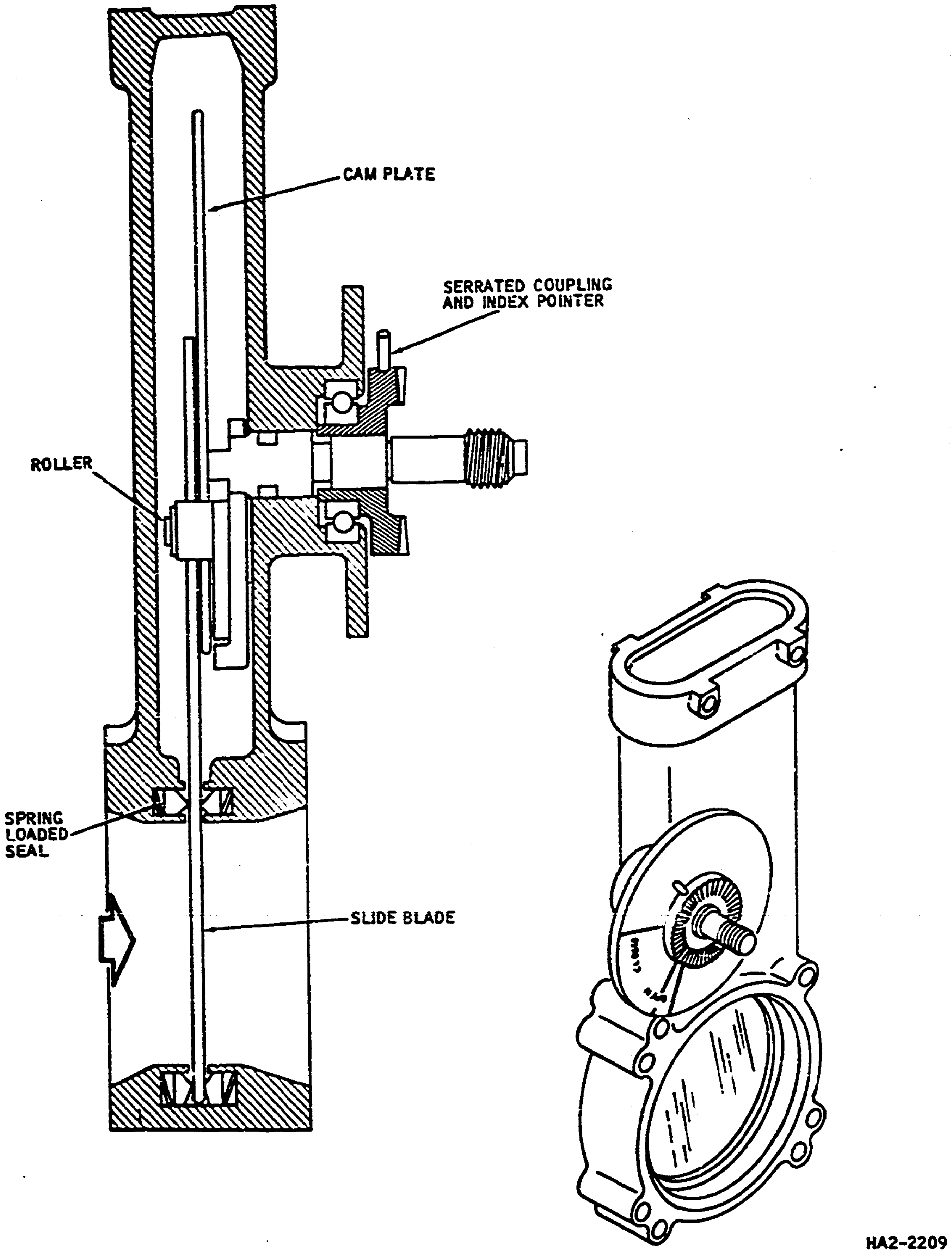
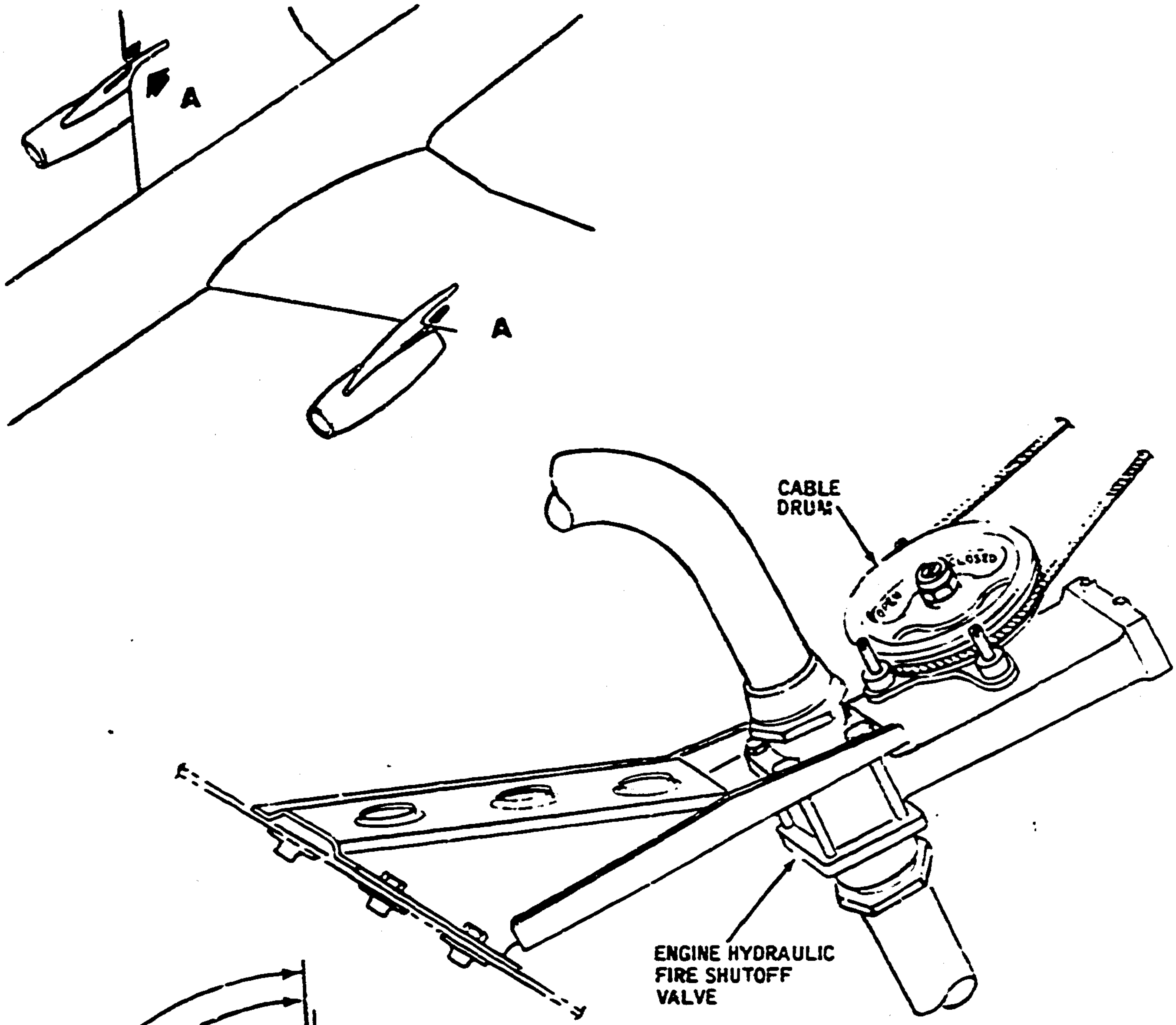
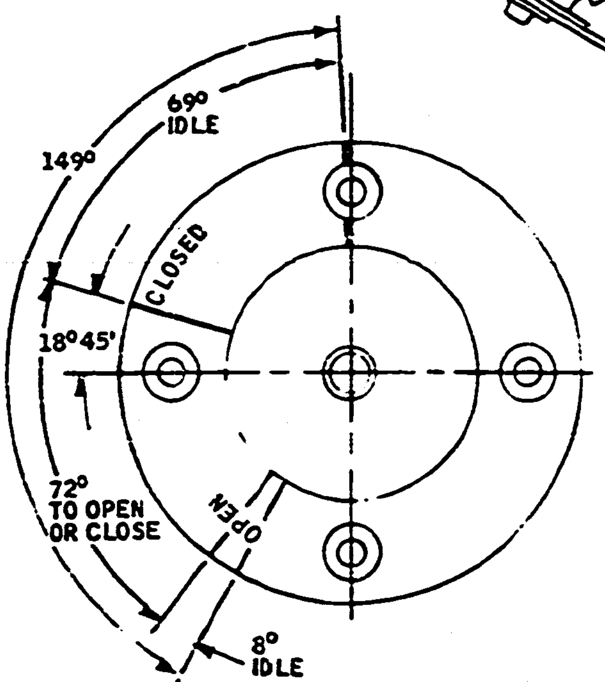


Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 13



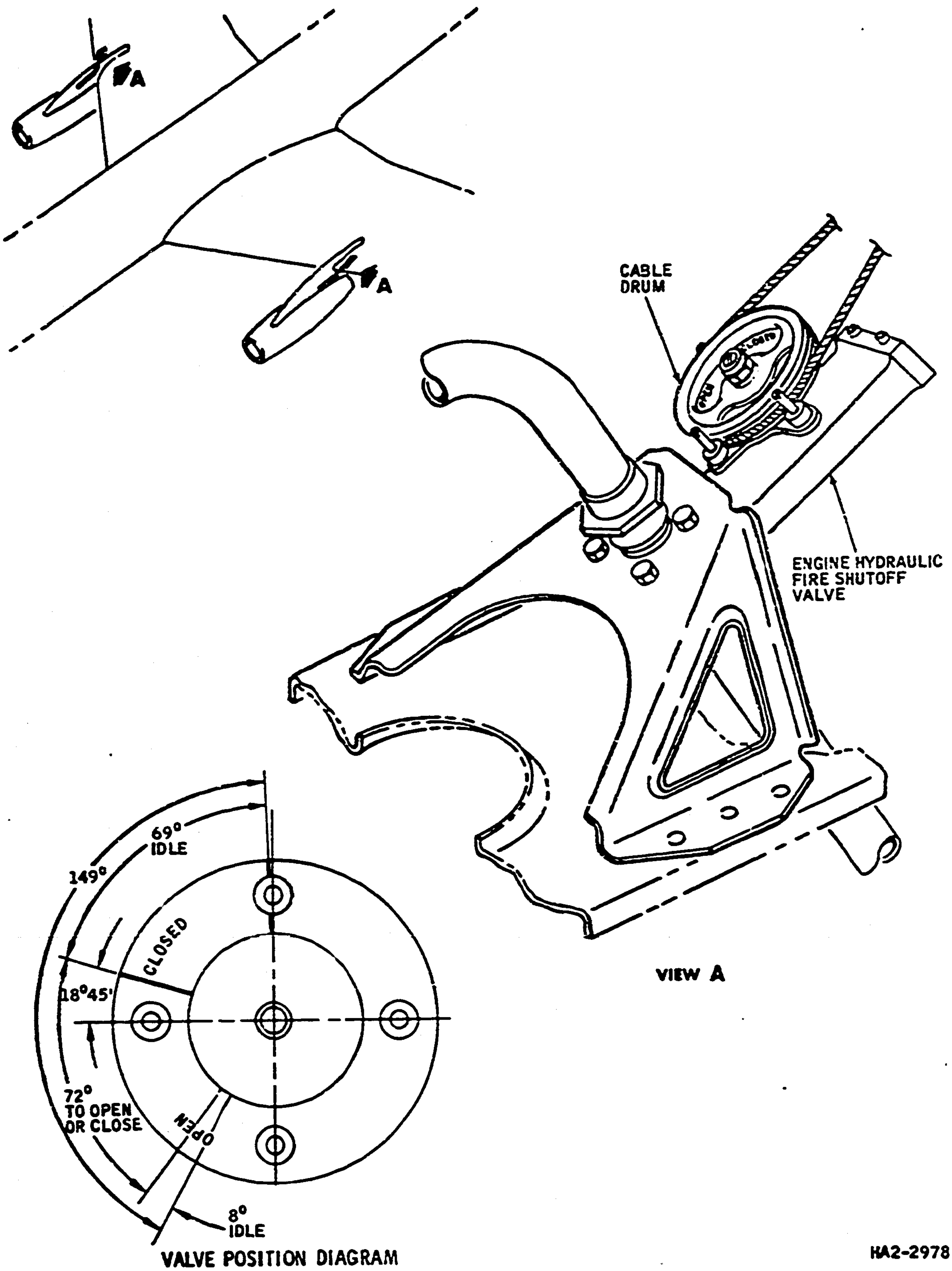
VIEW A



VALVE POSITION DIAGRAM

HA2-22

Engine Hydraulic Fire Shutoff Valve
(Airplanes 801-822, 860-866)
Figure 14 (Sheet 1)



Engine Hydraulic Fire Shutoff Valve
(Airplanes 867 and Subsequent)
Figure 14 (Sheet 2)

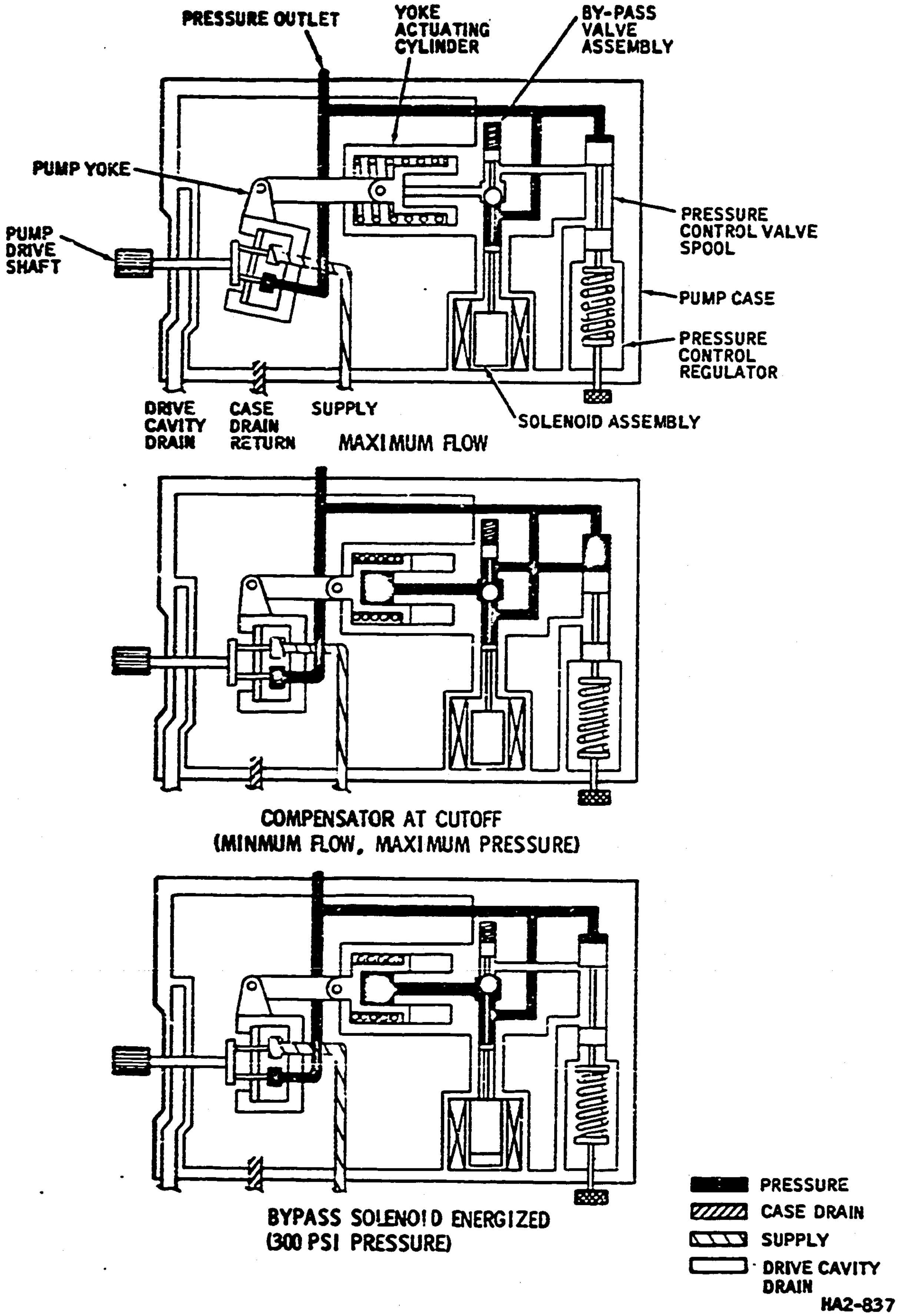
(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handles for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

M. Engine-Driven Hydraulic Pump (See Figure 15.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 15

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum to zero flow and 3000 psi is reached. The pump stabilizes in accordance with system demand.

N. Engine-Driven Hydraulic Pump Check Valves (See Figure 12.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

O. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 16.)

(1) Airplanes 812-822, 860 and subsequent are equipped with an engine-driven hydraulic pump case drain filter. The case drain filter is a line-type, micronic filter, for use in a low-pressure hydraulic system, installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

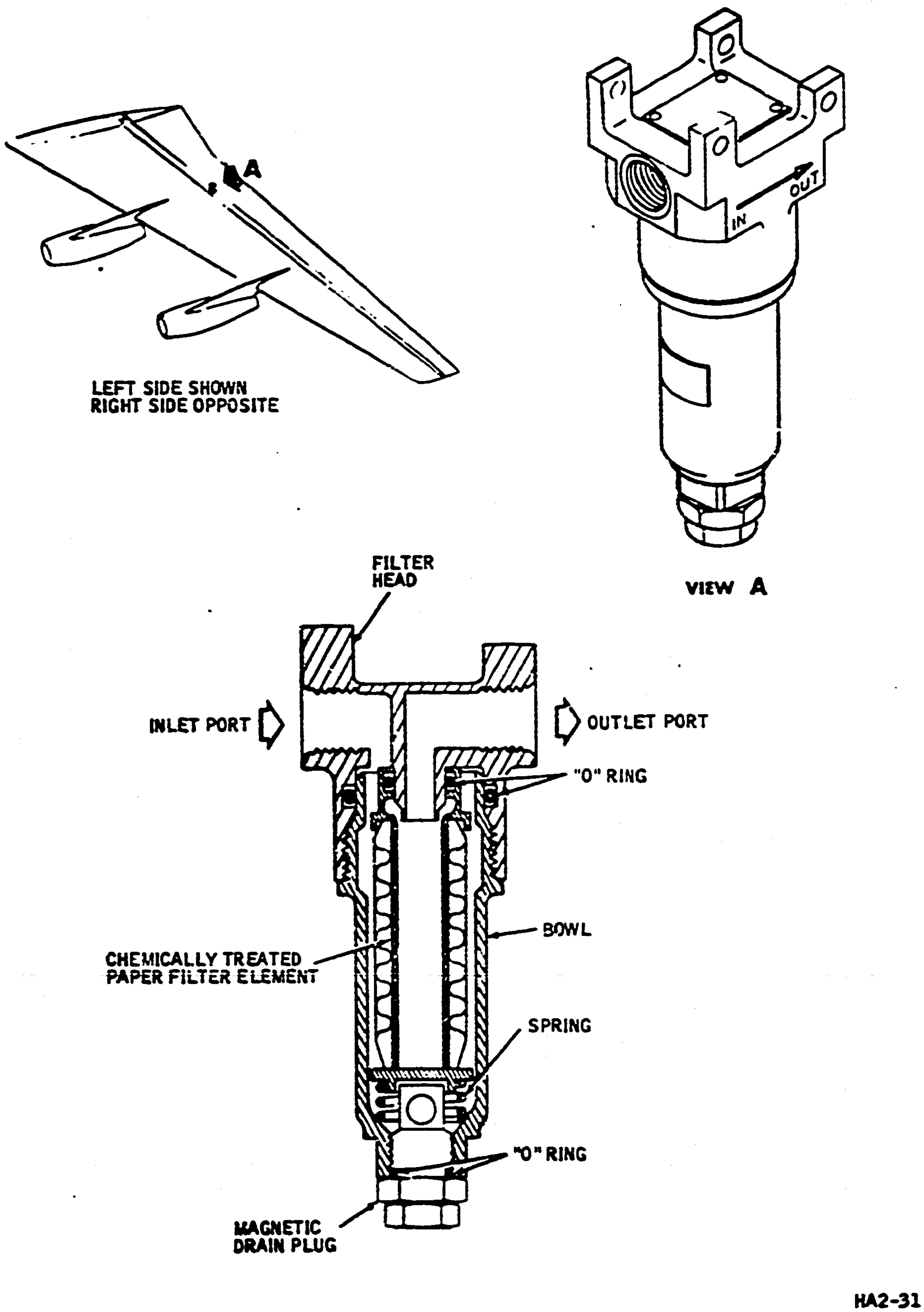
P. Dual Filter and Relief Valve (See Figure 17.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

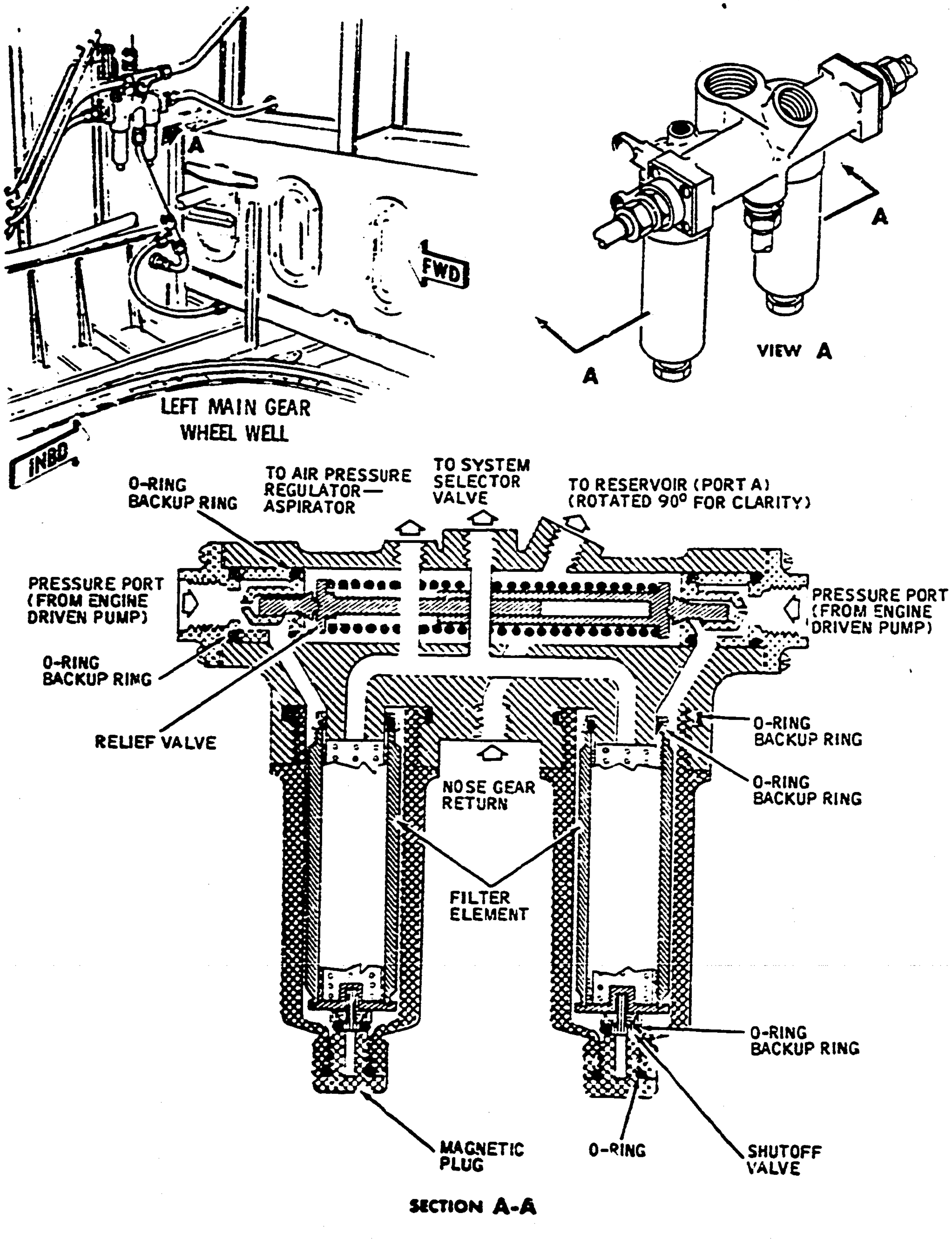
(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.



Engine-Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
(Airplanes 812-822, 860 and Subsequent)
Figure 16



Dual Filter and Relief Valve -- Cutaway View
Figure 17

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

Q. System Selector Valve (See Figure 18 and 19.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

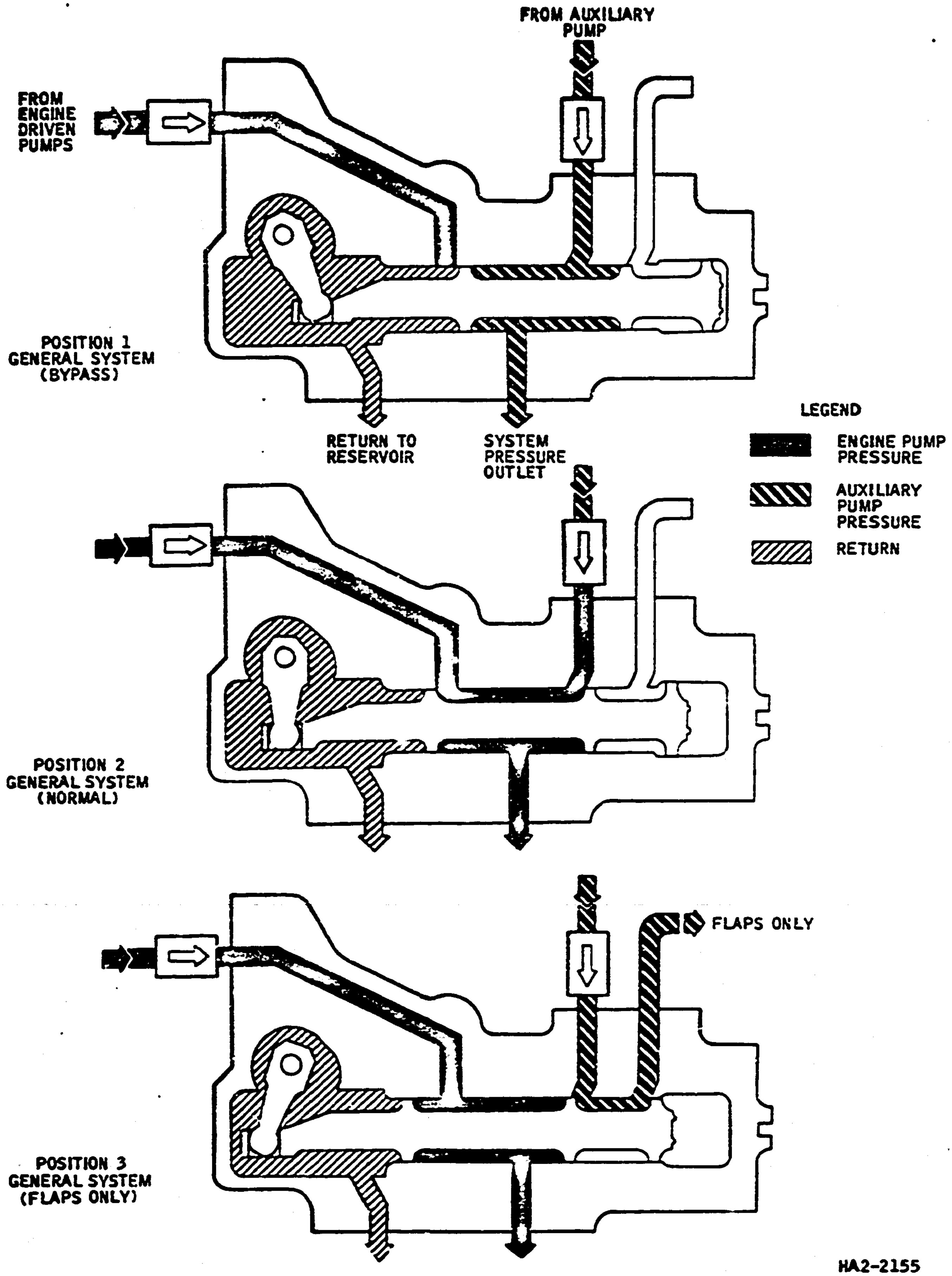
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/flaps only position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps. Internal leakage provides lubrication for the moving parts of the valve.

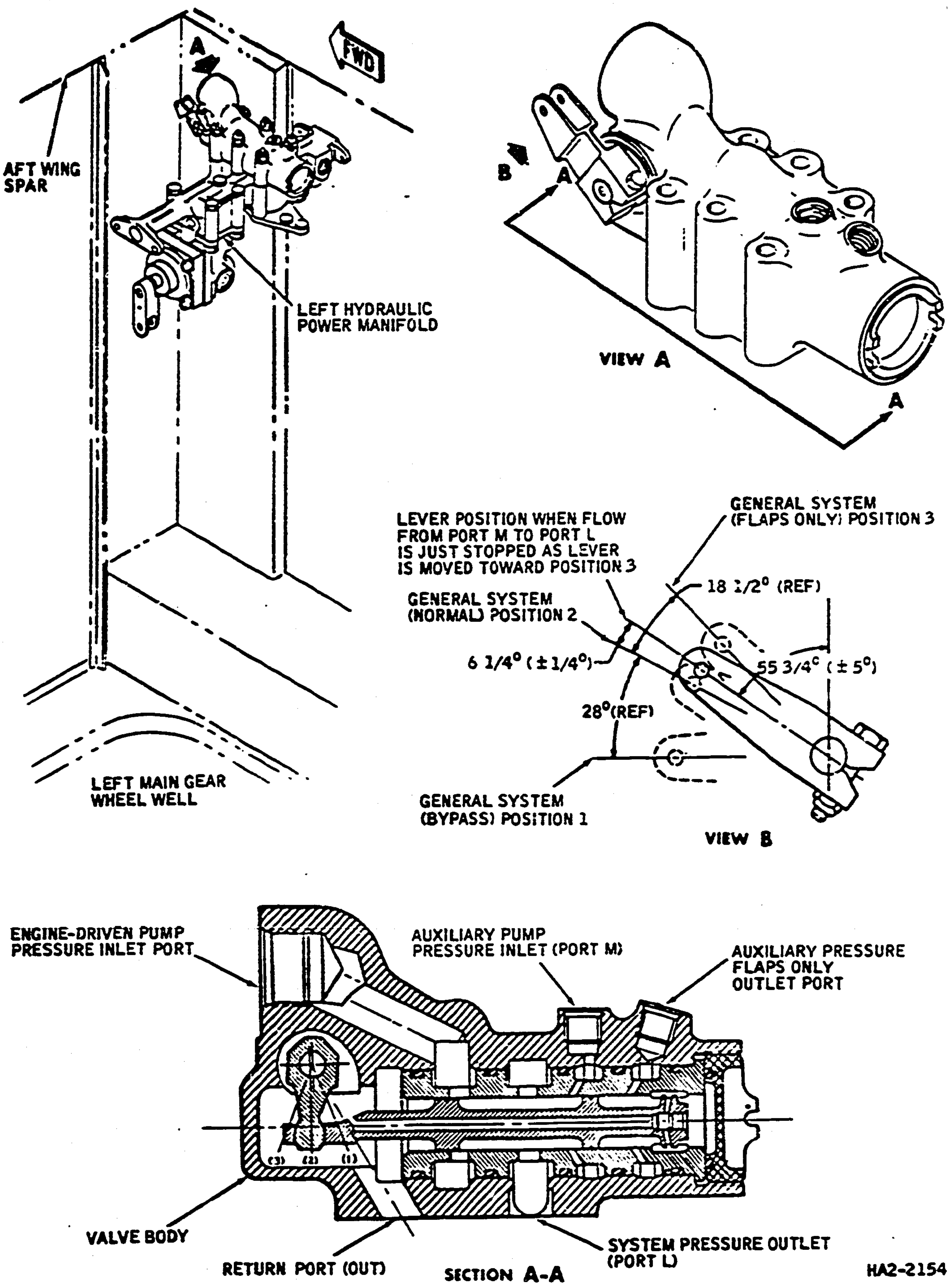
R. Left Hydraulic Power Manifold (See Figure 20.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

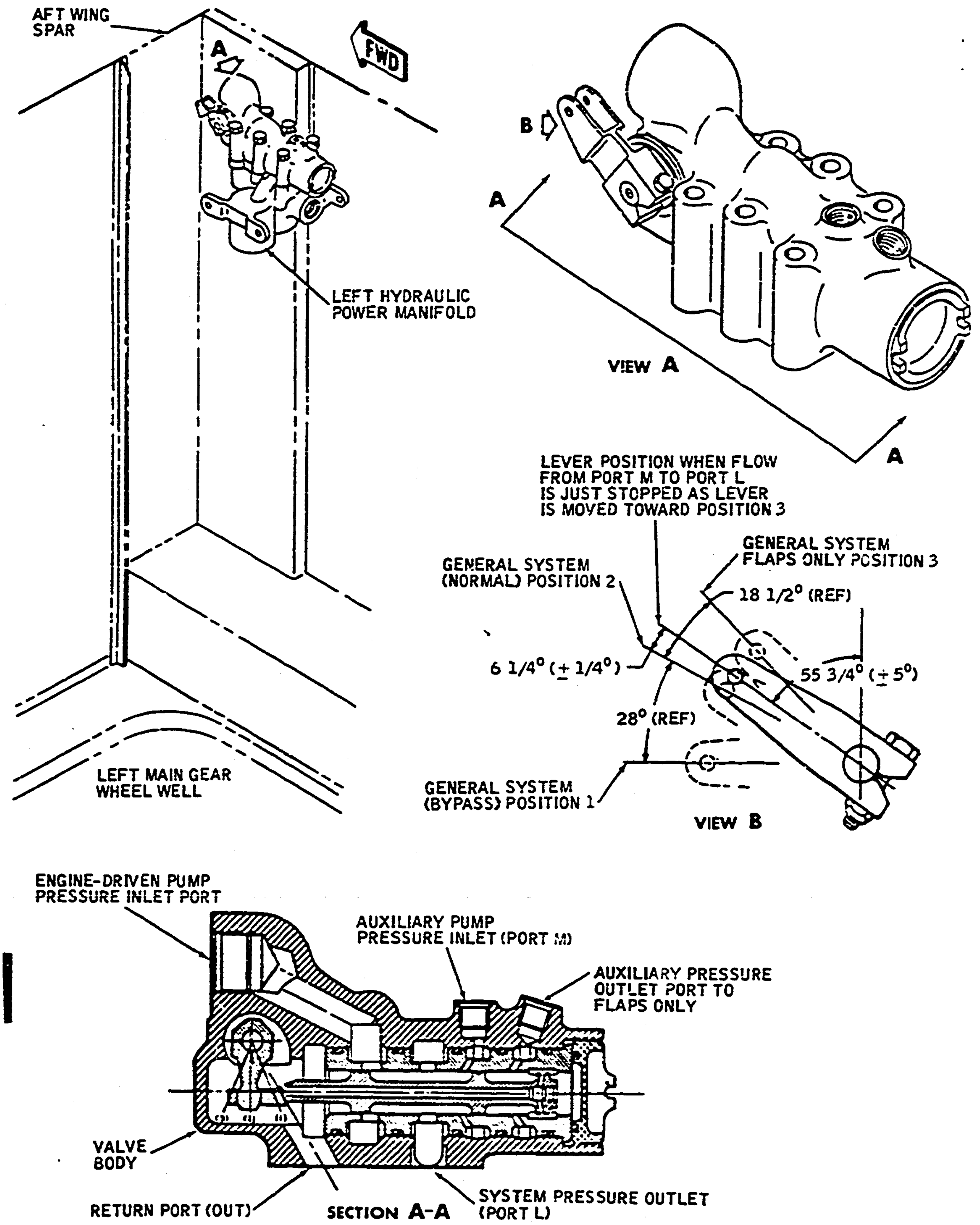
(2) On airplanes 801-822 and 860-866, three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is used for the engine ejector emergency air control valve on airplanes 801-811. On airplanes 812-822, 860-866, this pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve on airplanes 801-822, 860-866. On airplanes 867 and subsequent, there is no bogie unlock system, and a different type of manifold is used.



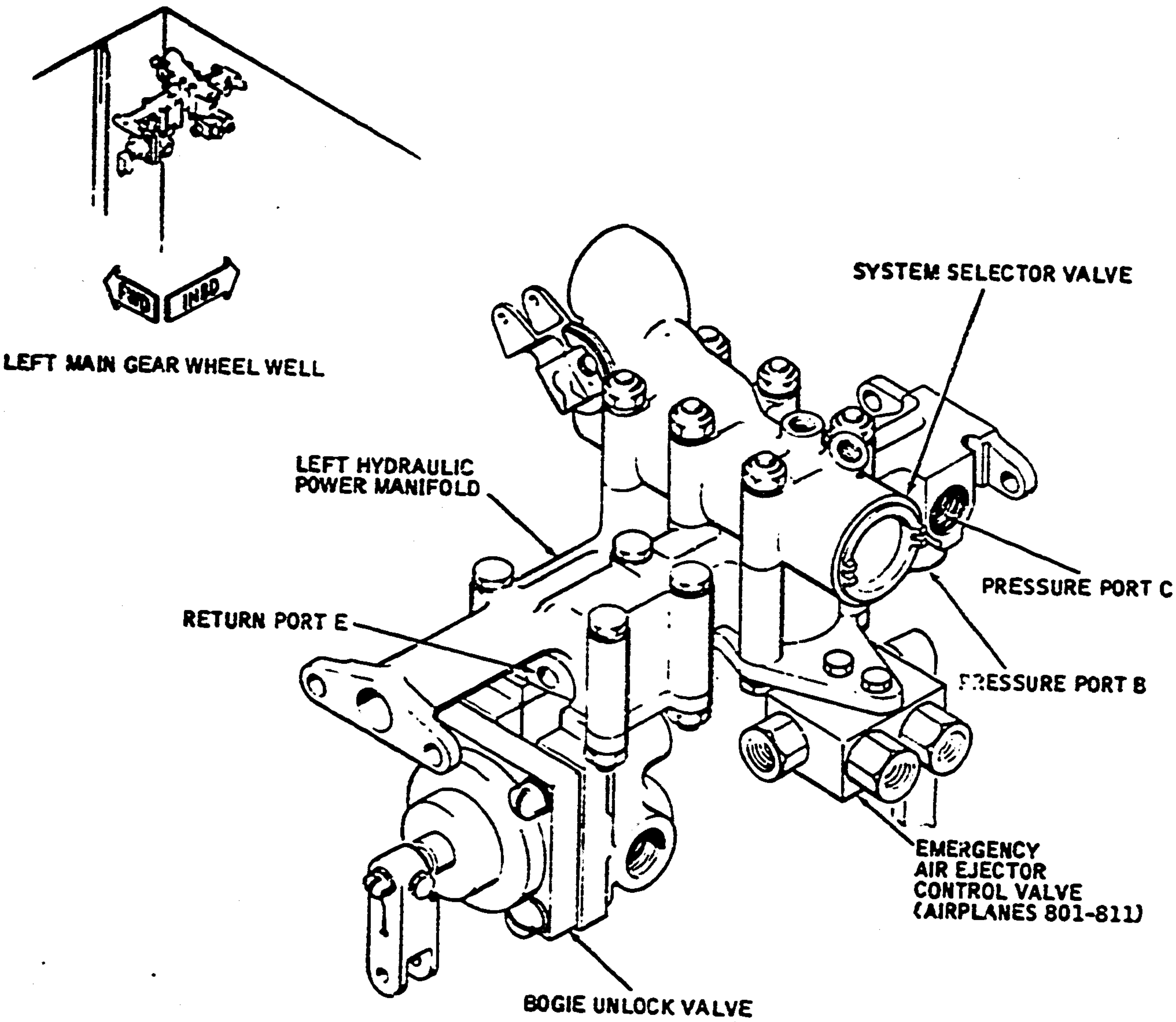
System Selector Valve -- Schematic
Figure 18

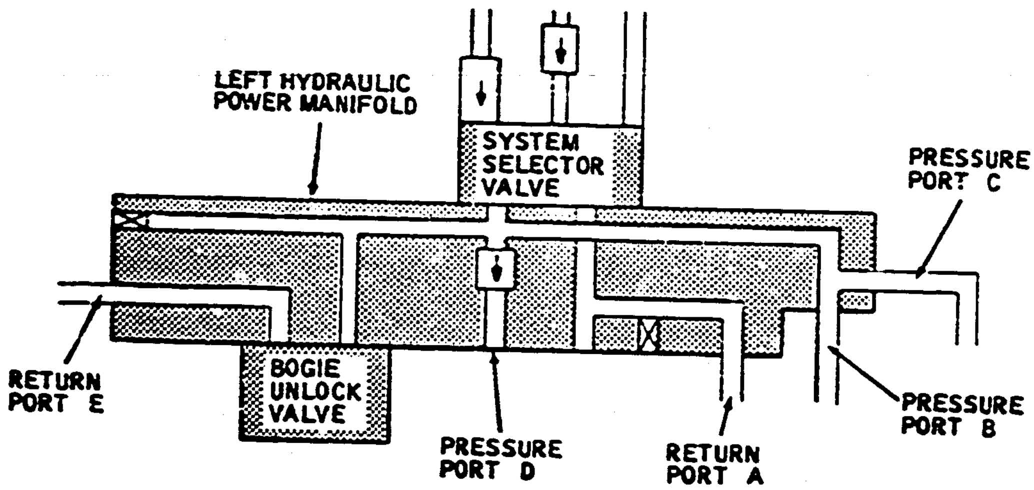


System Selector Valve -- Cutaway View
(Airplanes 801-822, 860-866)
Figure 19 (Sheet 1)



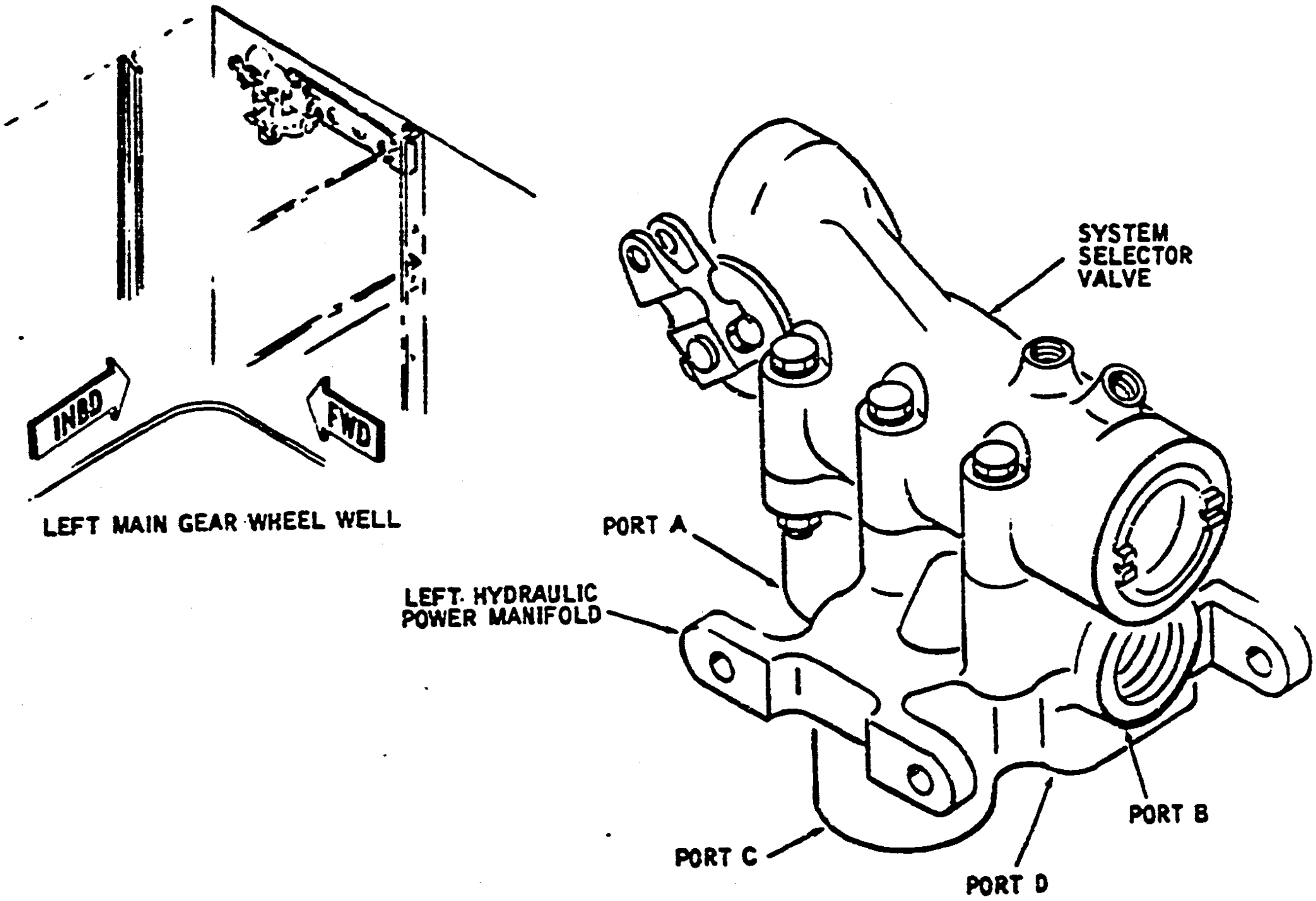
System Selector Valve -- Cutaway View
(Airplanes 867 and Subsequent)
Figure 19 (Sheet 2)

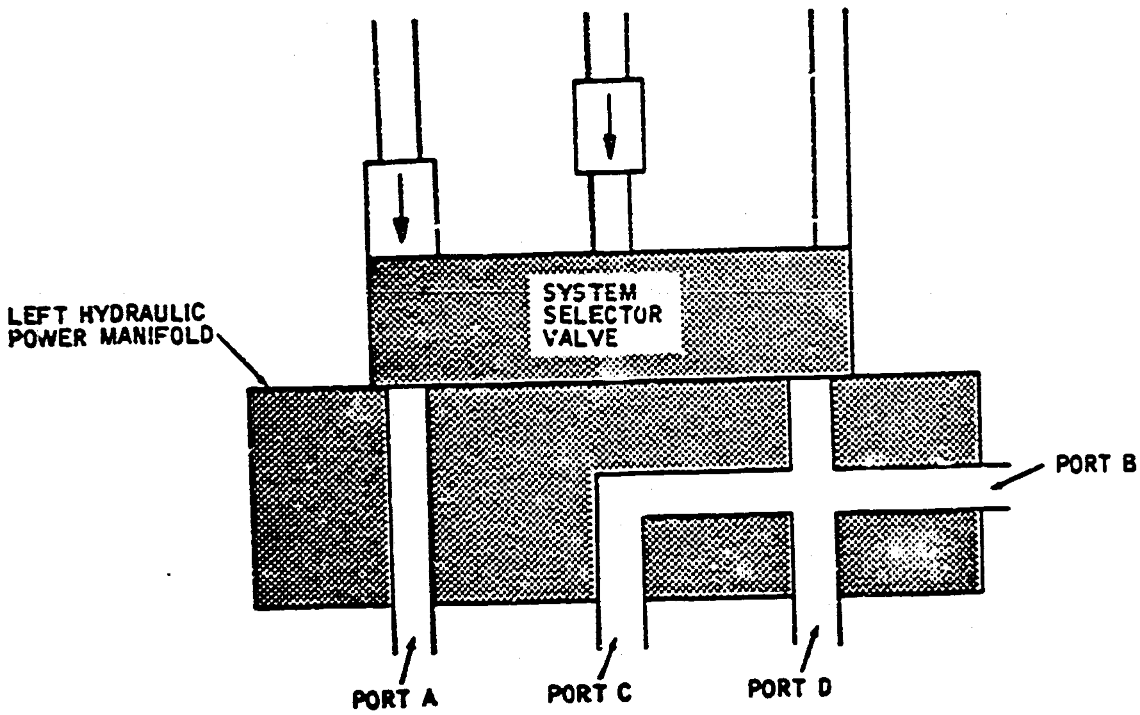




HA2-4653

Left Hydraulic Power Manifold -- Schematic
(Airplanes 801-822, 860-866)
Figure 20 (Sheet 1)





HA2-855

Left Hydraulic Power Manifold -- Schematic
(Airplanes 867 and Subsequent)
Figure 20 (Sheet 2)

Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold pressure outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

(3) On airplanes 867 and subsequent, one valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

S. Right Hydraulic Power Manifold (See Figure 21.)

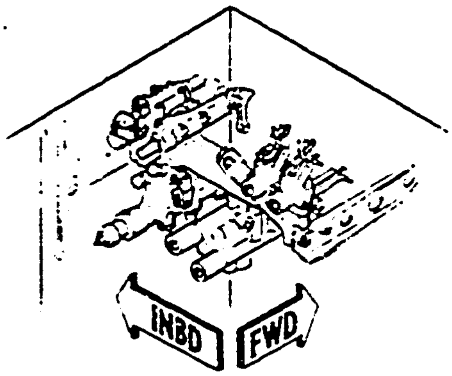
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

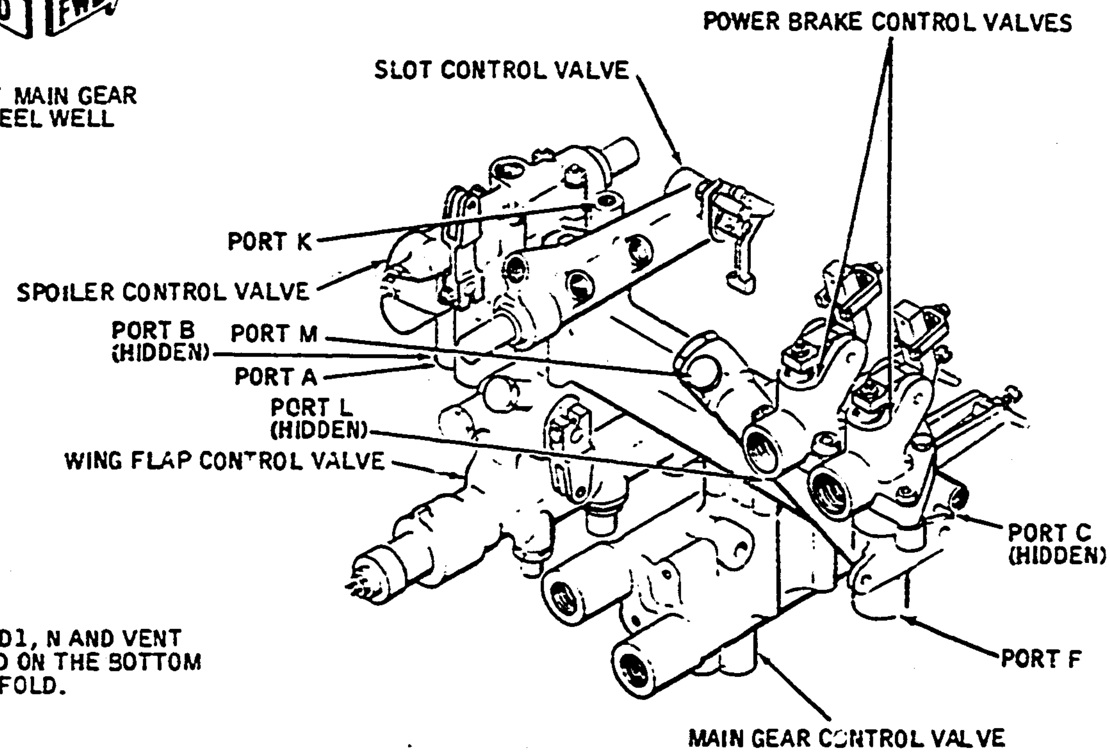
(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

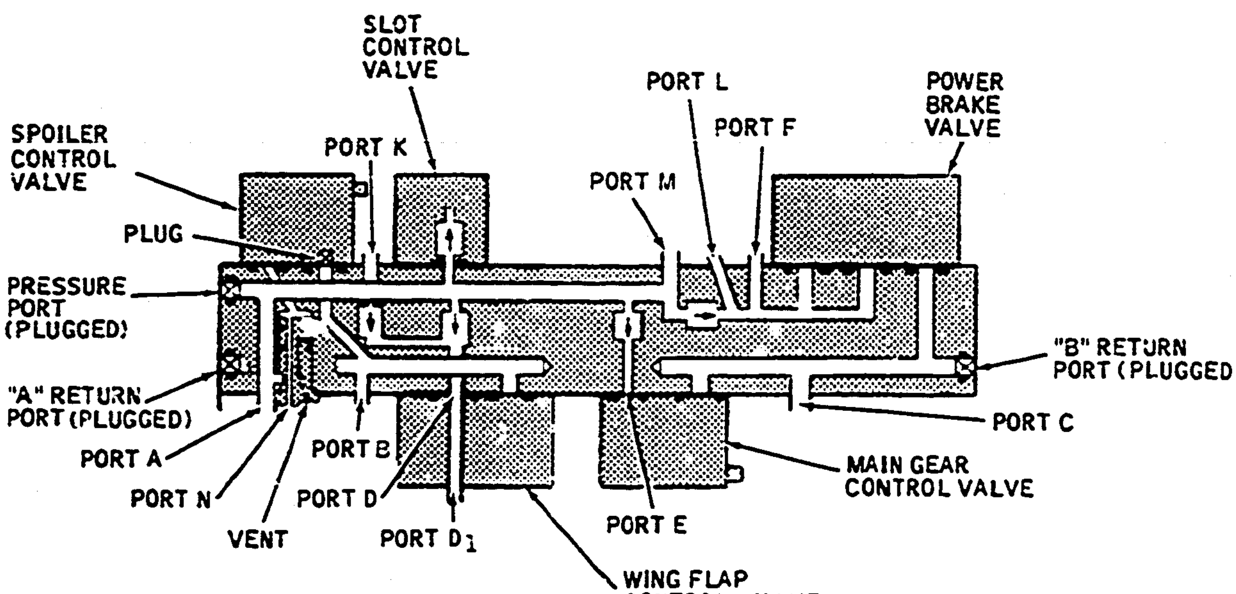
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.





NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 21

T. Hydraulic Manifold Return Check Valves (Airplanes 801-822, 860-866, see Figure 12.)

(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear in inboard door.

(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.

U. Hydraulic Power System Accumulator (See Figure 22.)

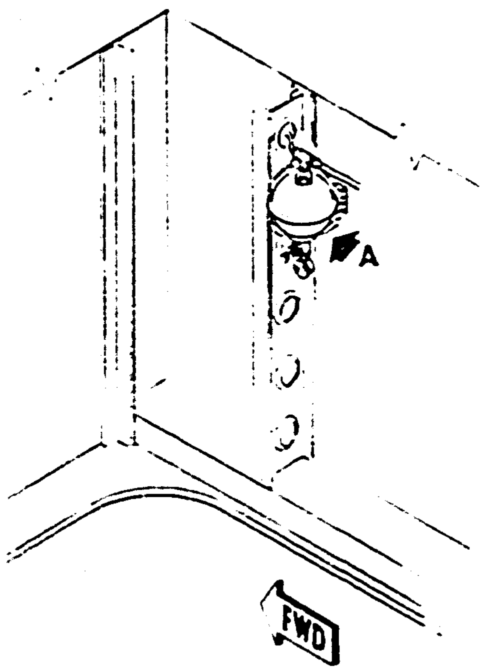
(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

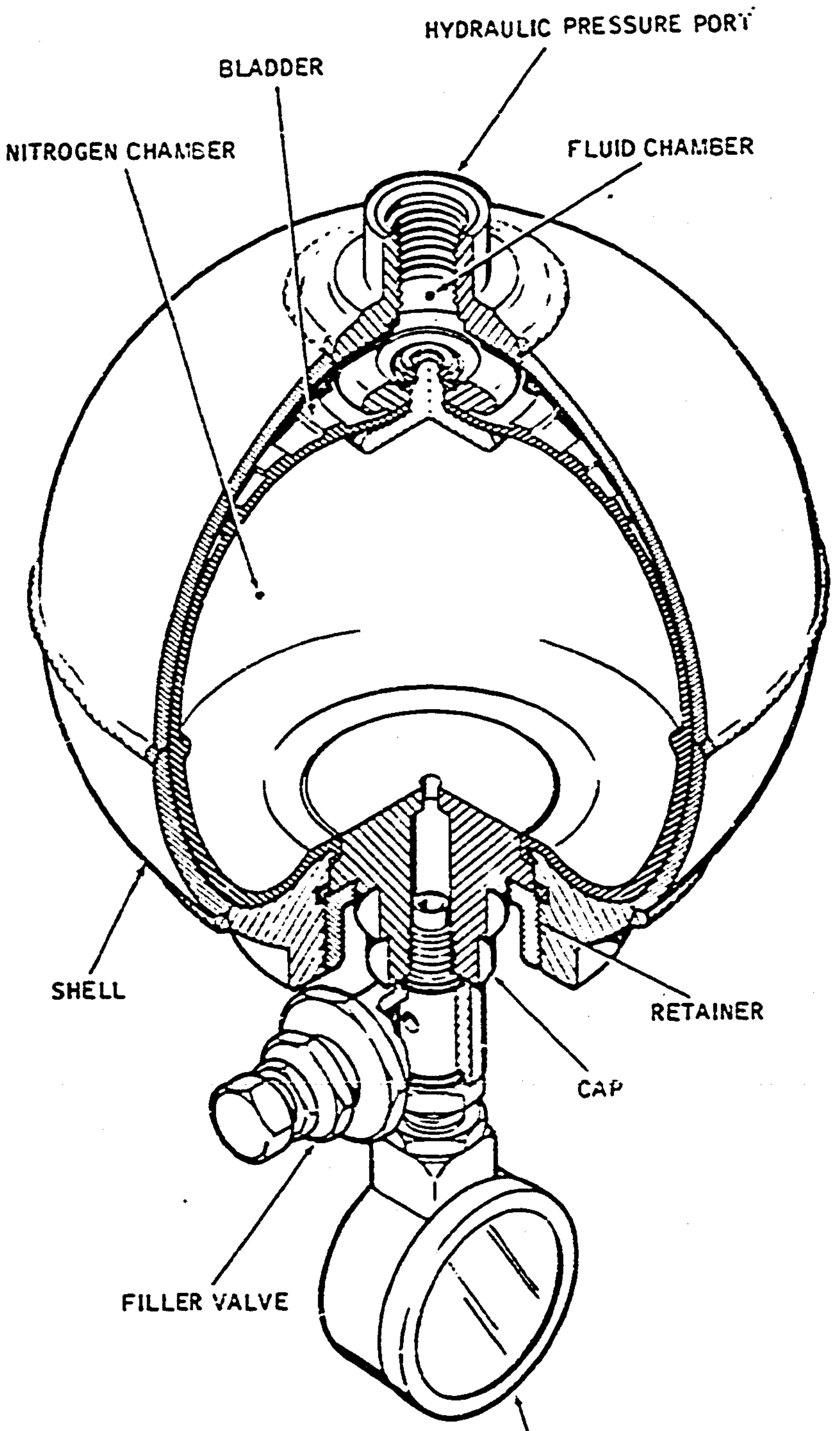
(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smoothes out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate), until a quantity equal to the stored volume in the accumulator has been used by the system.

V. Hydraulic System Priority Valve (See Figure 23.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber

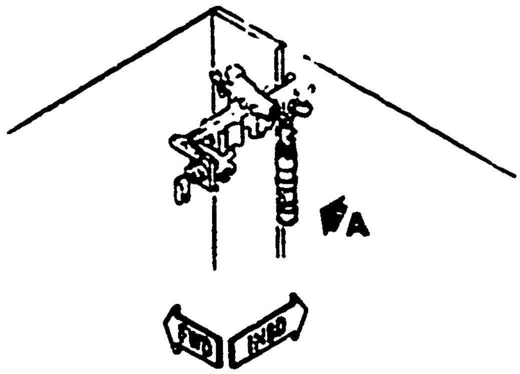




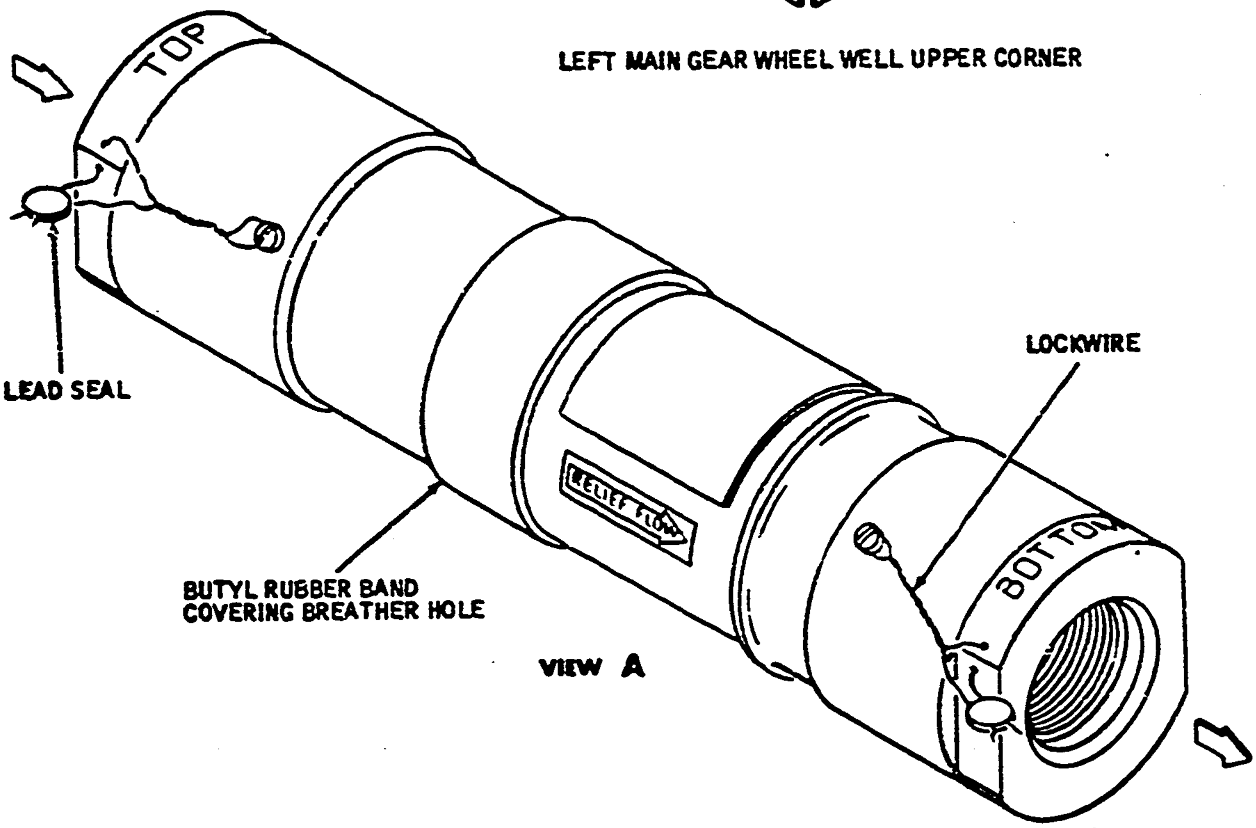
VIEW A

HA2-7578

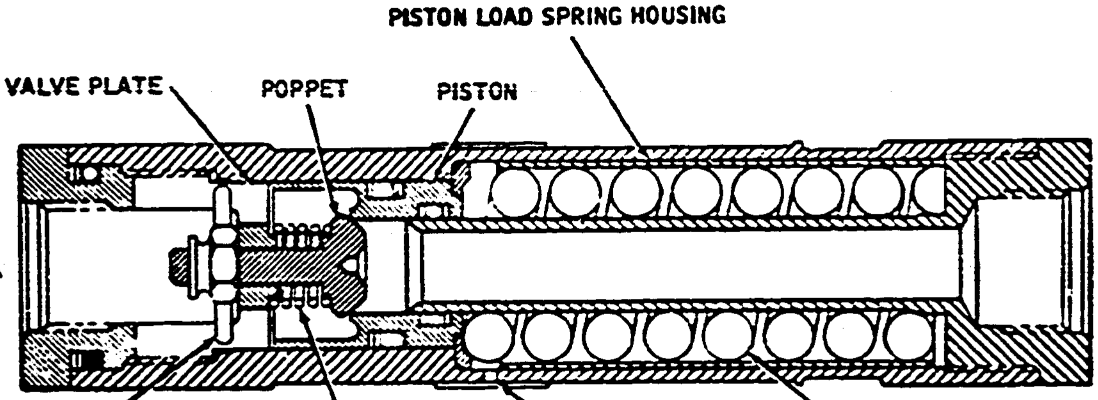
Hydraulic Power System Accumulator --
Cutaway View
Figure 22



LEFT MAIN GEAR WHEEL WELL UPPER CORNER



VIEW A



HA2-34

Hydraulic System Priority Valve -- Cutaway View
Figure 23

is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10-12 seconds)

(b) Gear extension -- 14 gpm (10-12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

W. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a

mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/flaps only position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve only. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

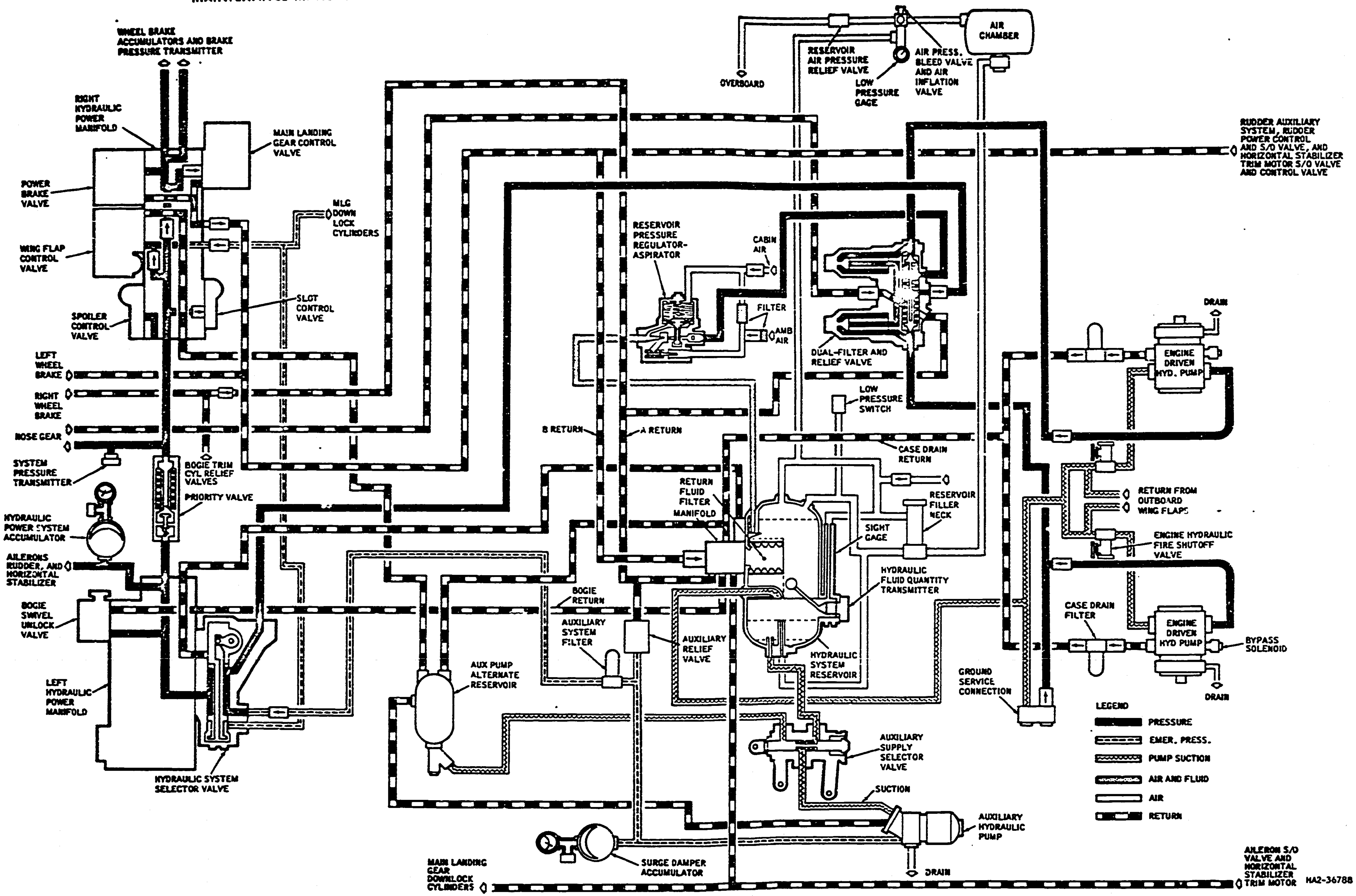
(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

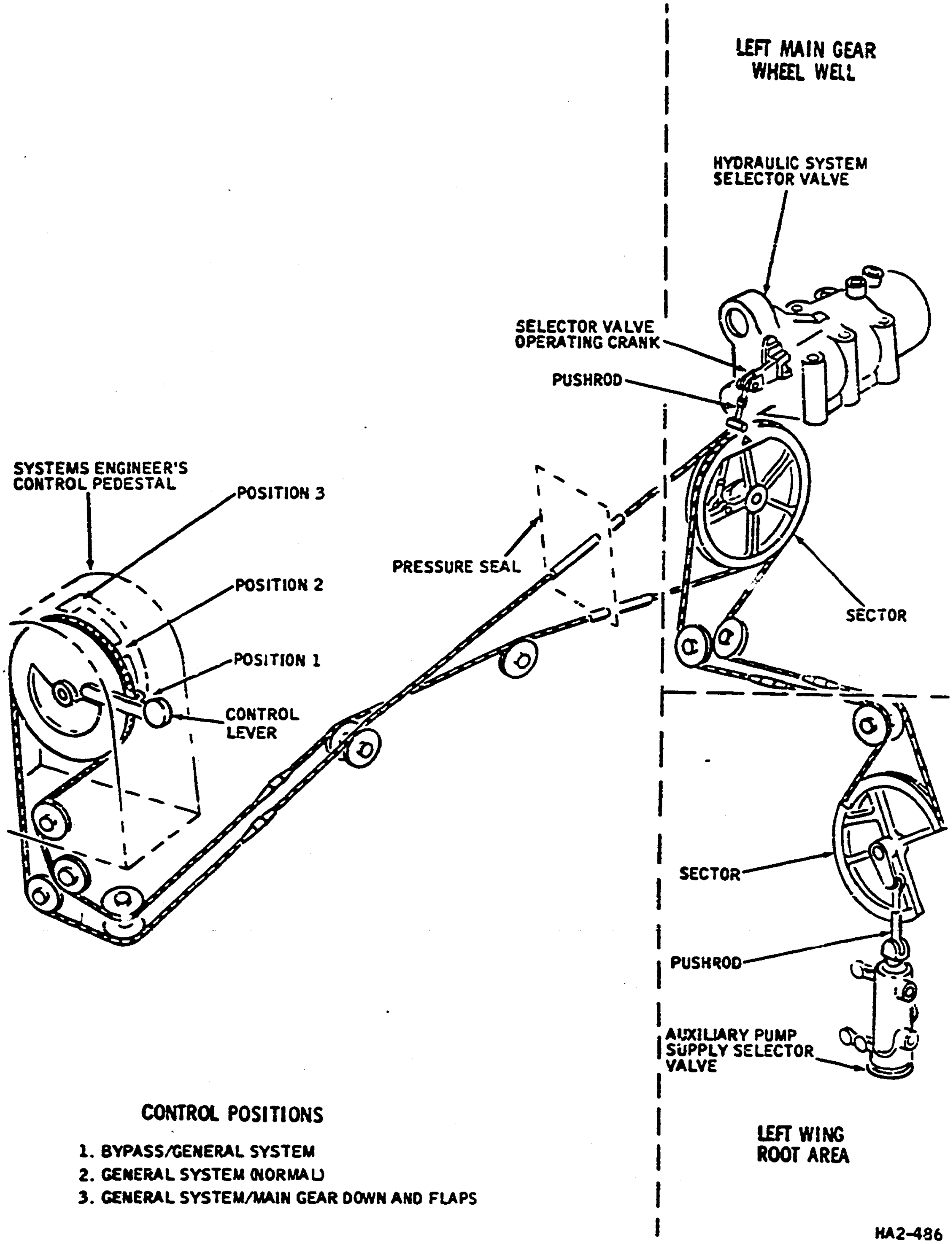
B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.



Hydraulic Power System -- Schematic Diagram
Figure 1



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm and the relief valve maintain 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

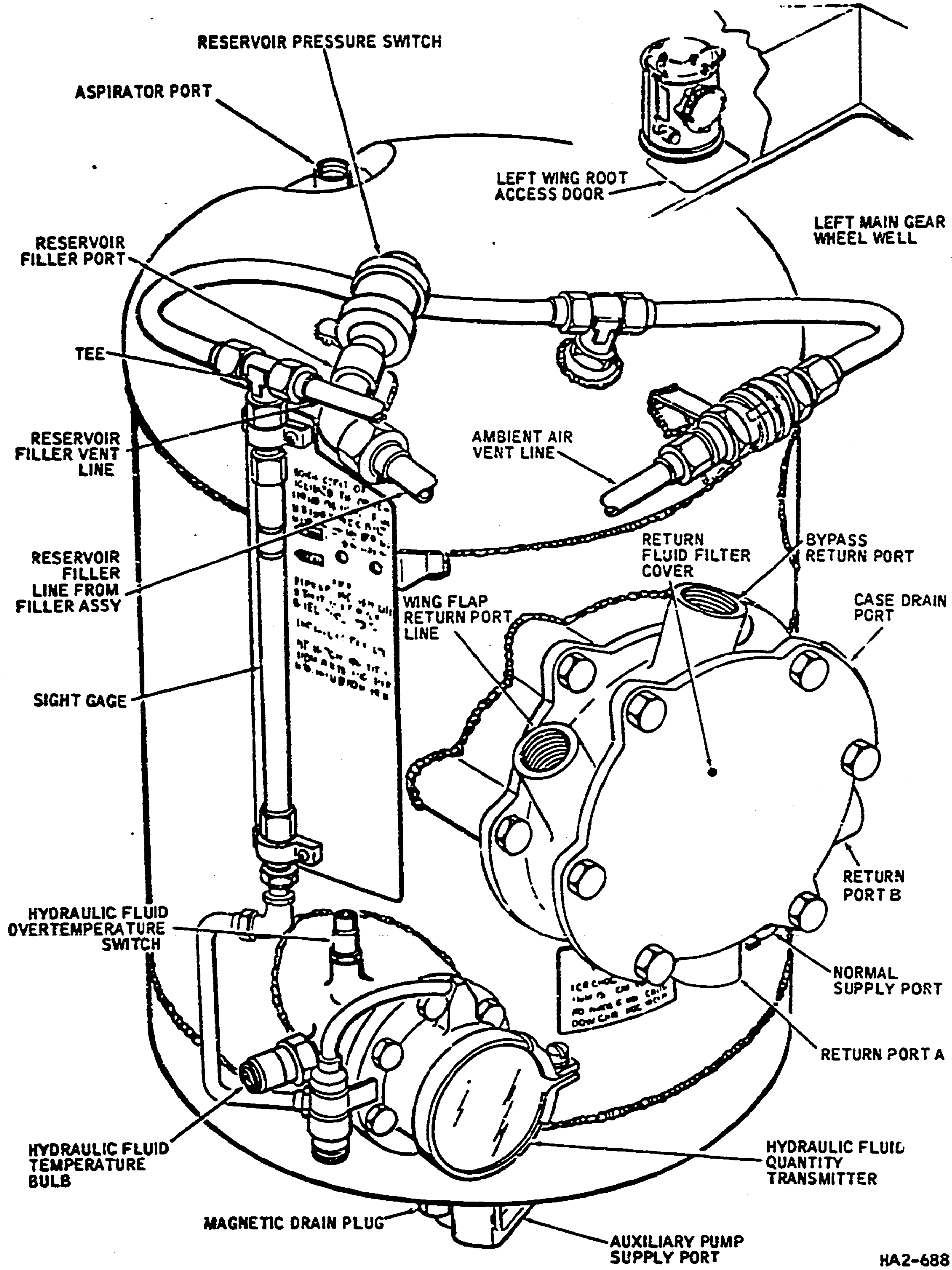
A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

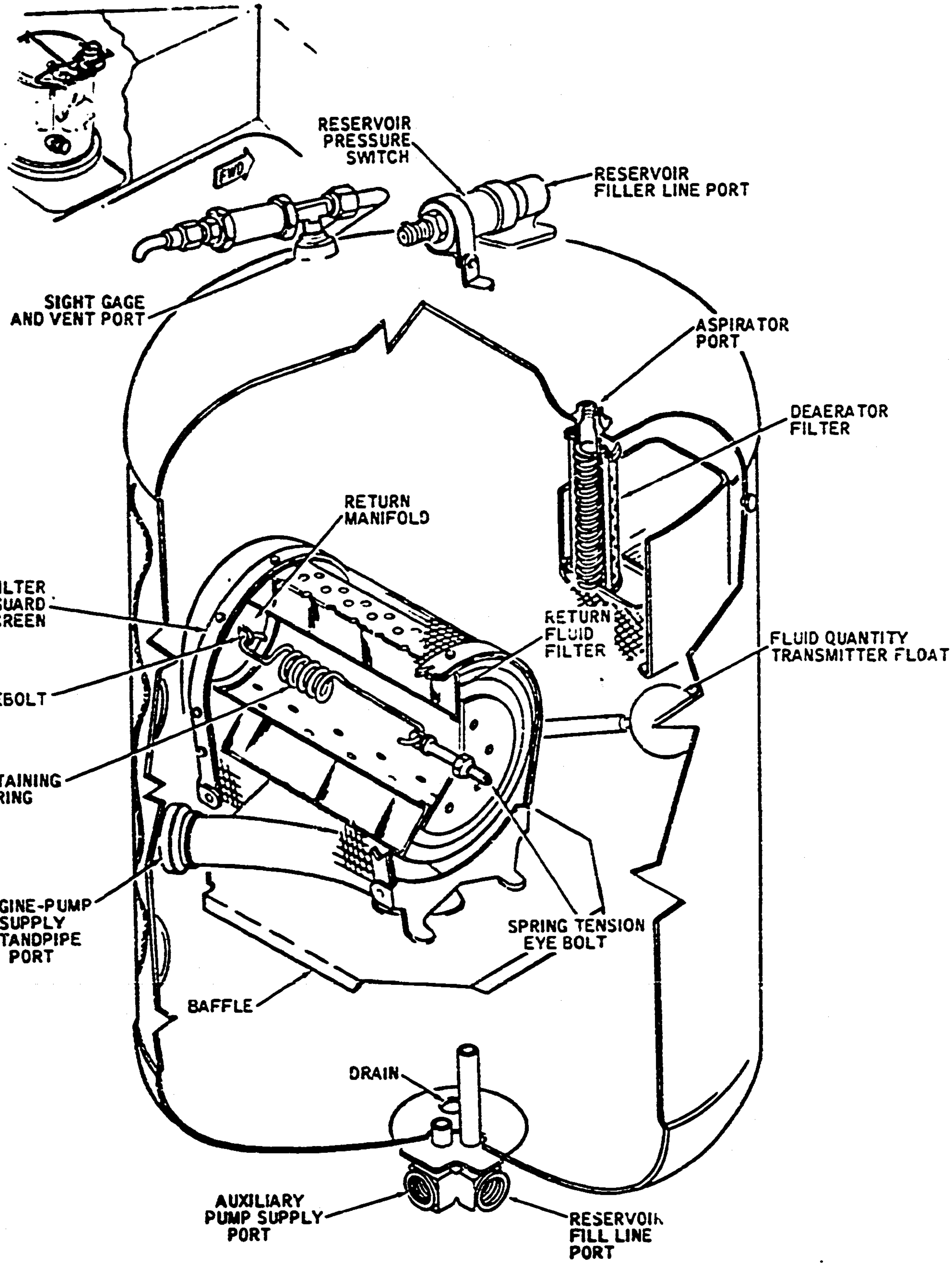
(2) The reservoir is pressurized with air from the regulator-aspirator to between 30 and 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

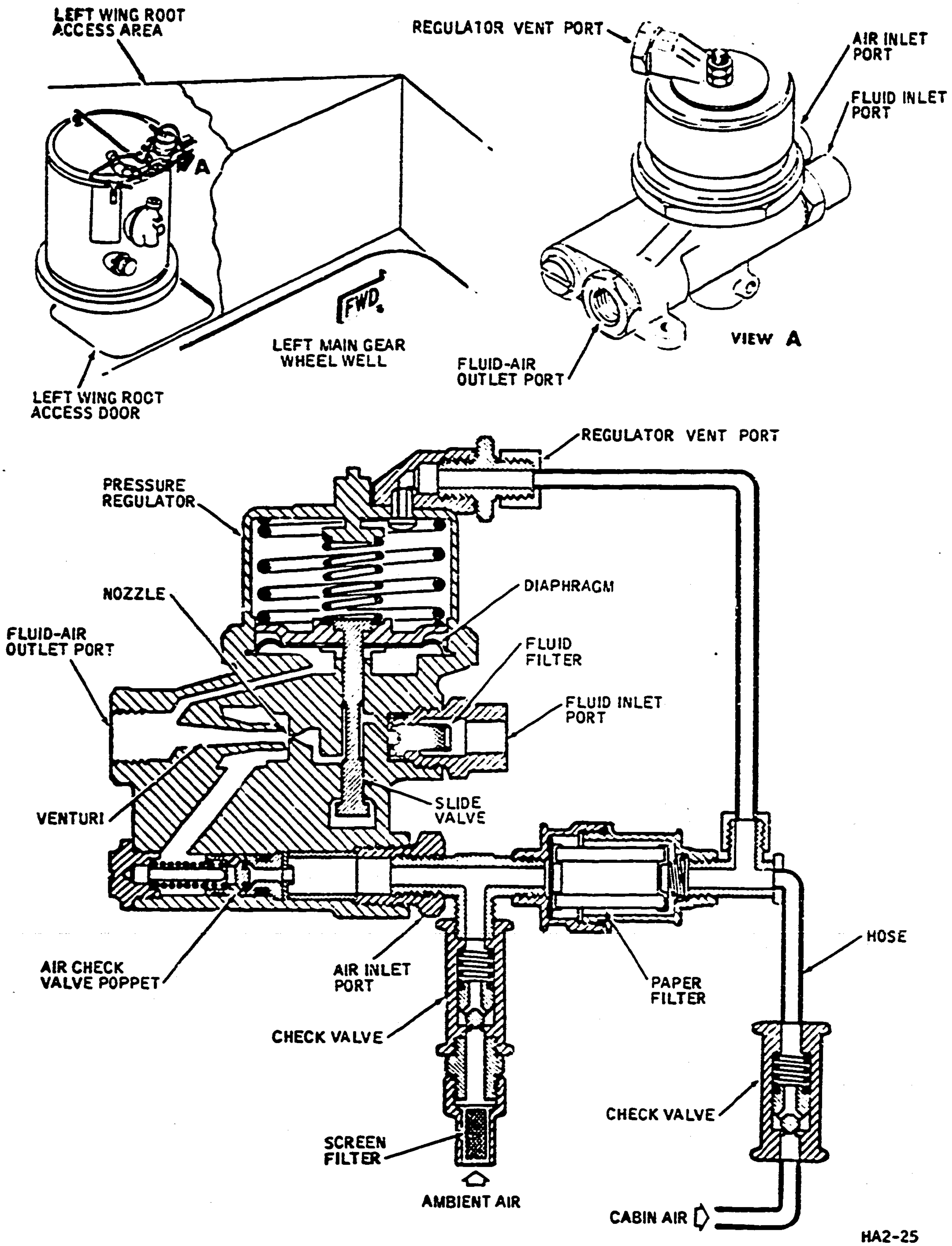
(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently stamped inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. When air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.



Reservoir Air Pressure Regulator-Aspirator --
Schematic
Figure 5

(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

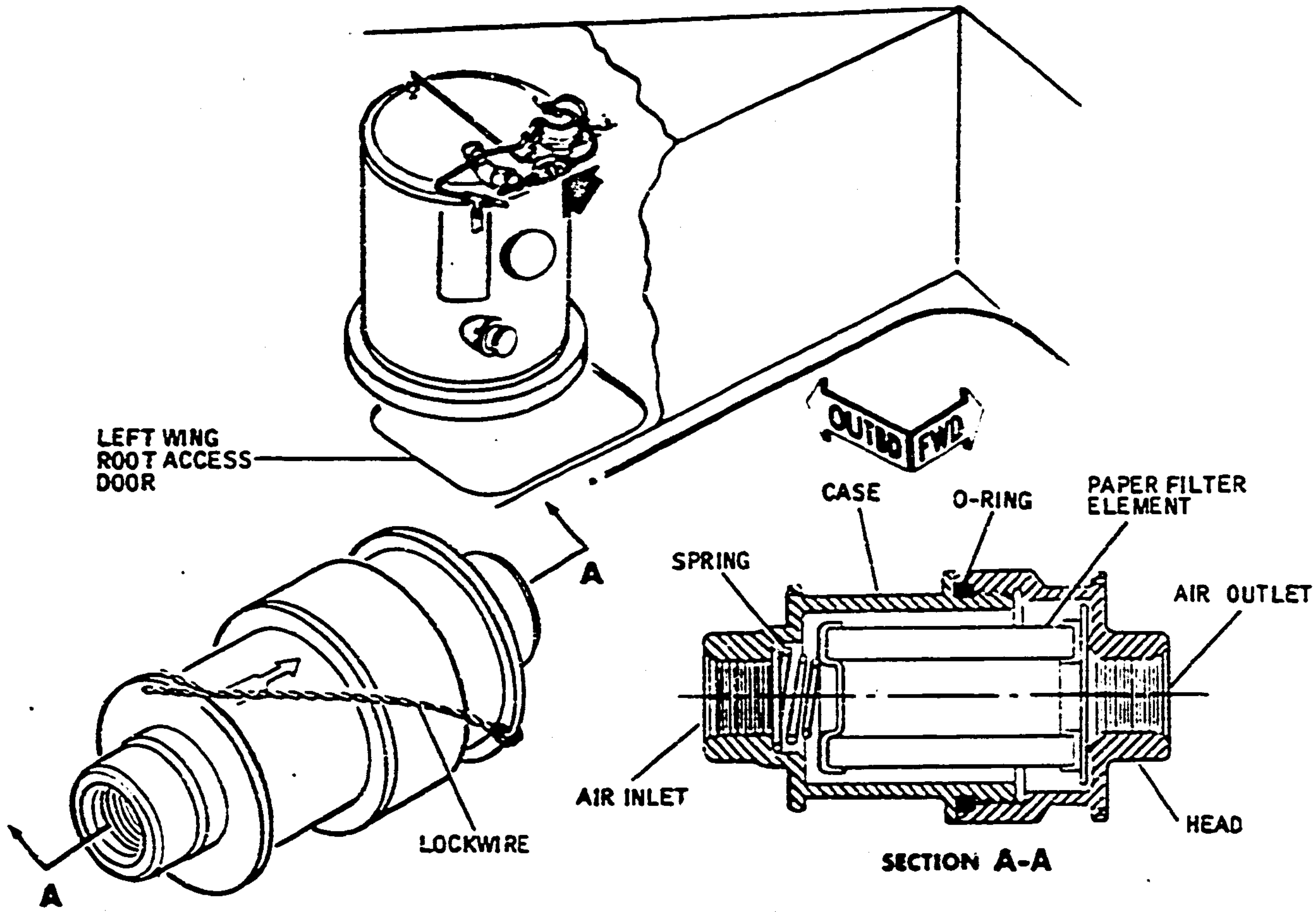
(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

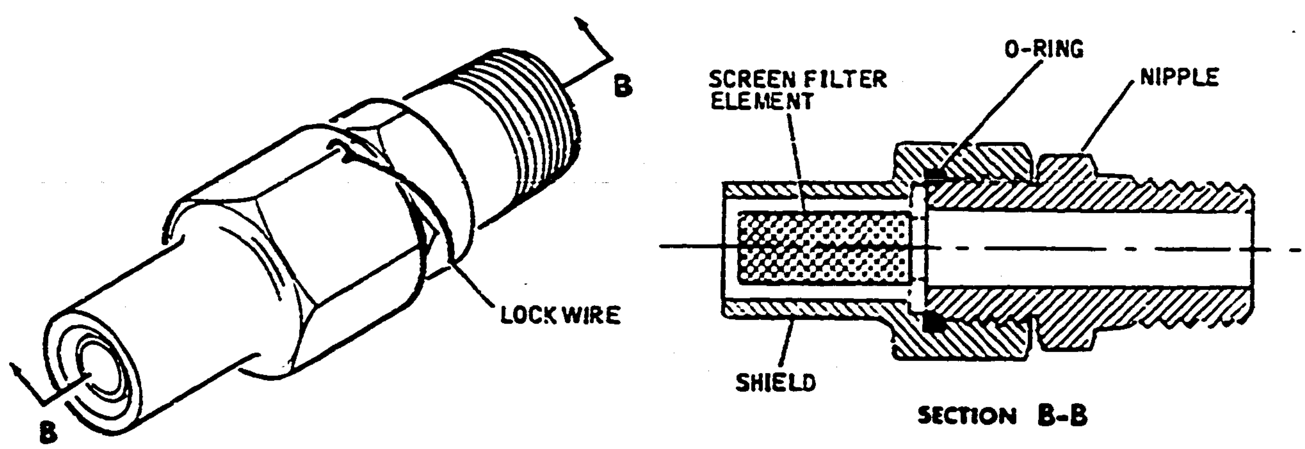
(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.



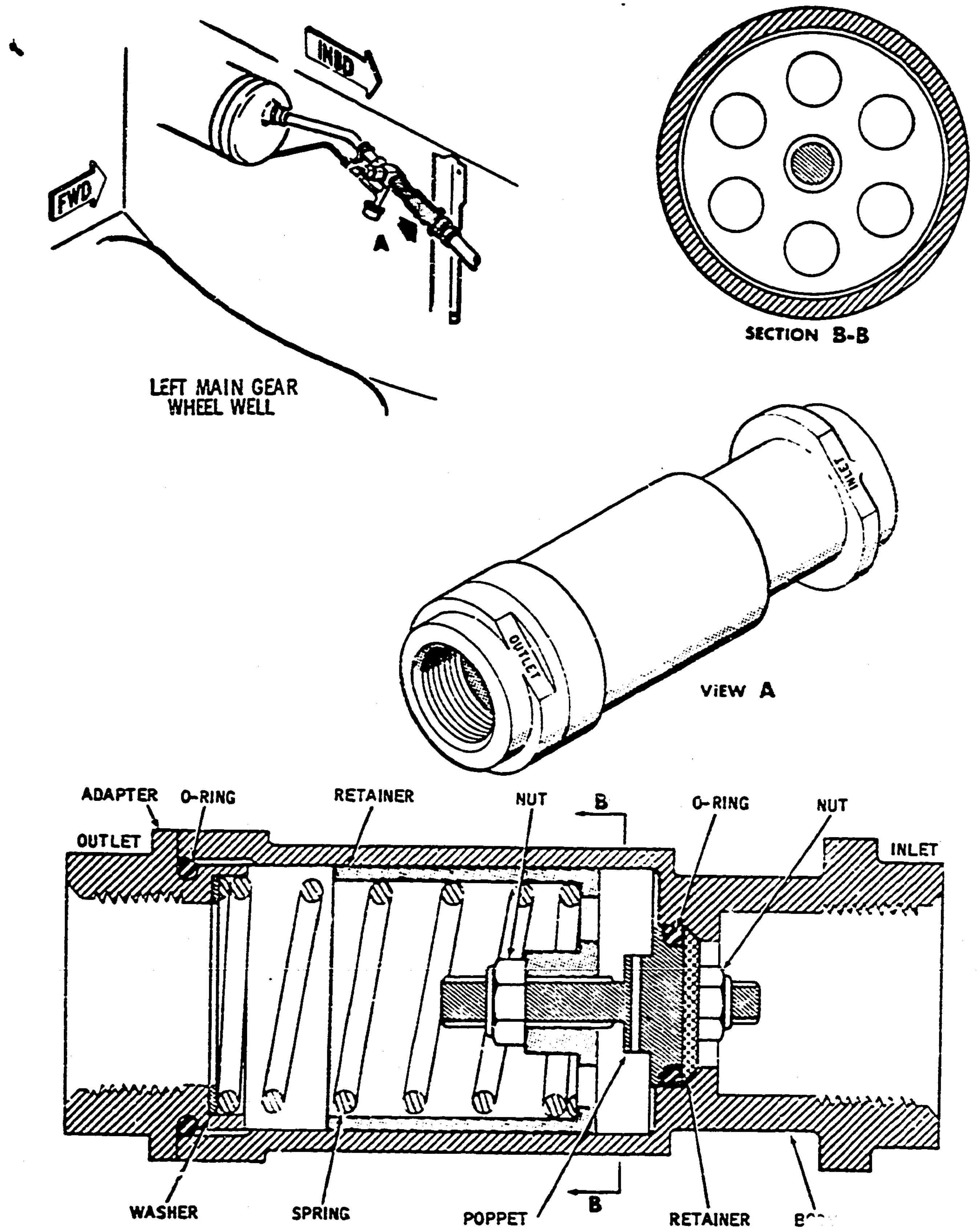
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters --
Cutaway View
Figure 6



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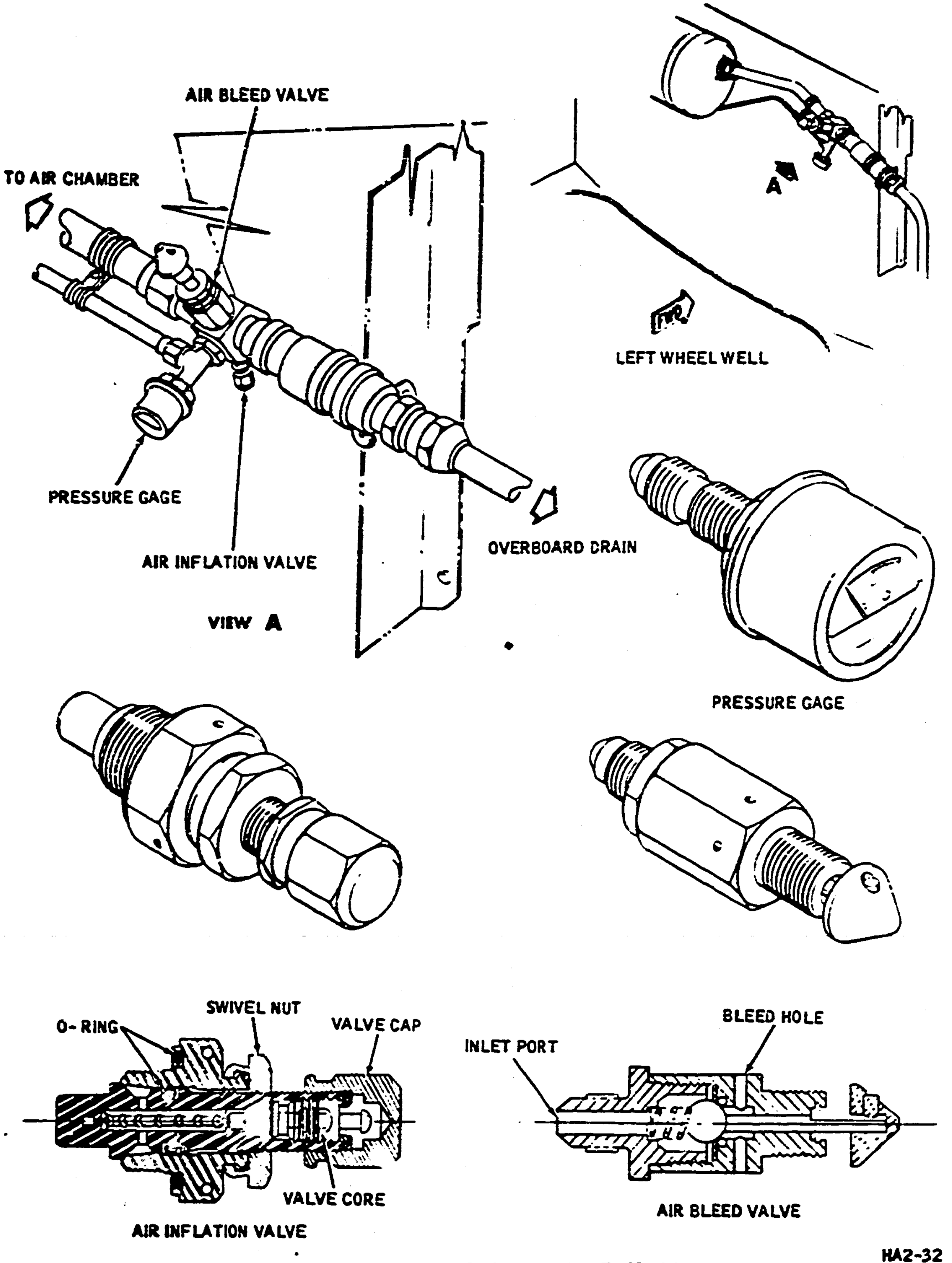
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

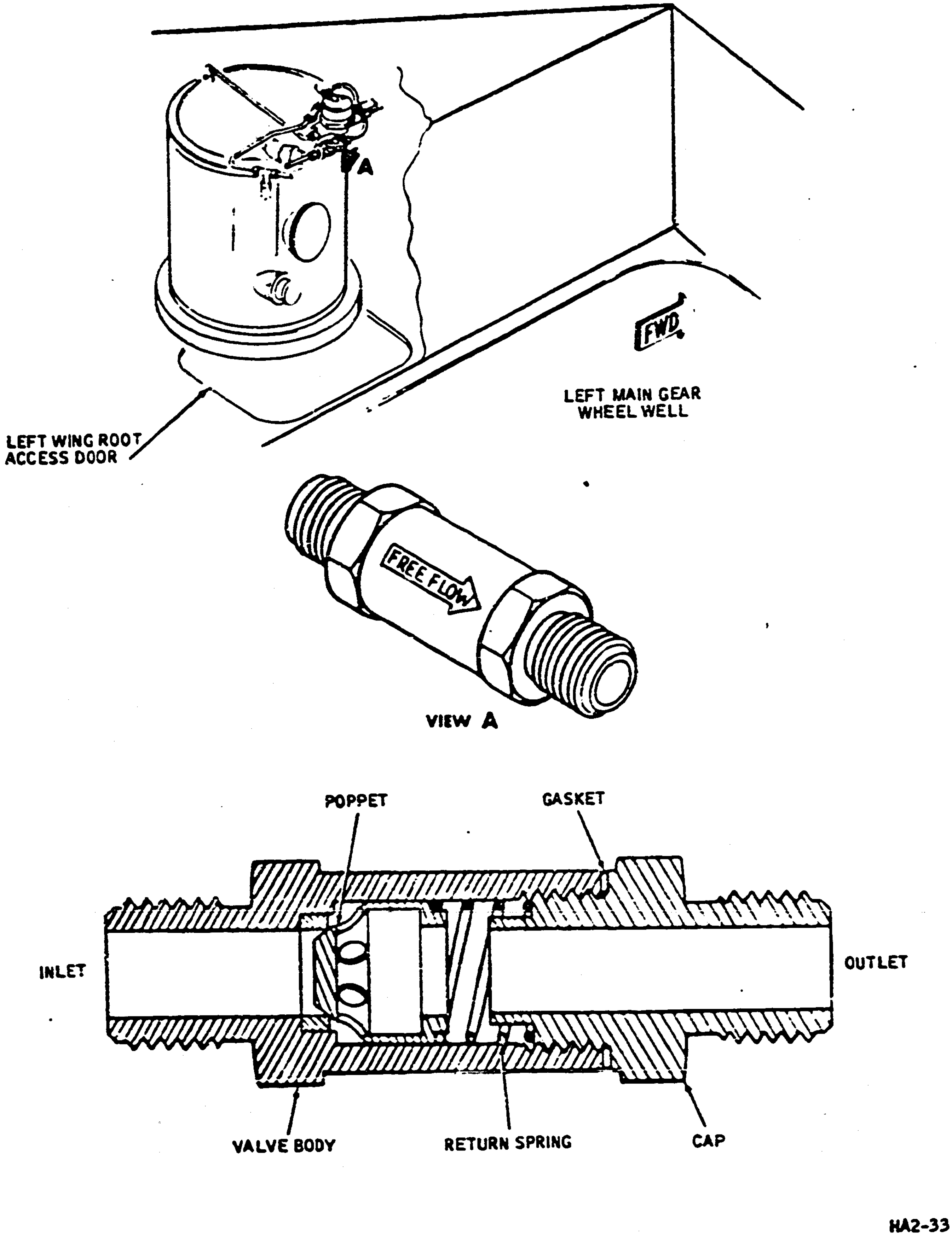
(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

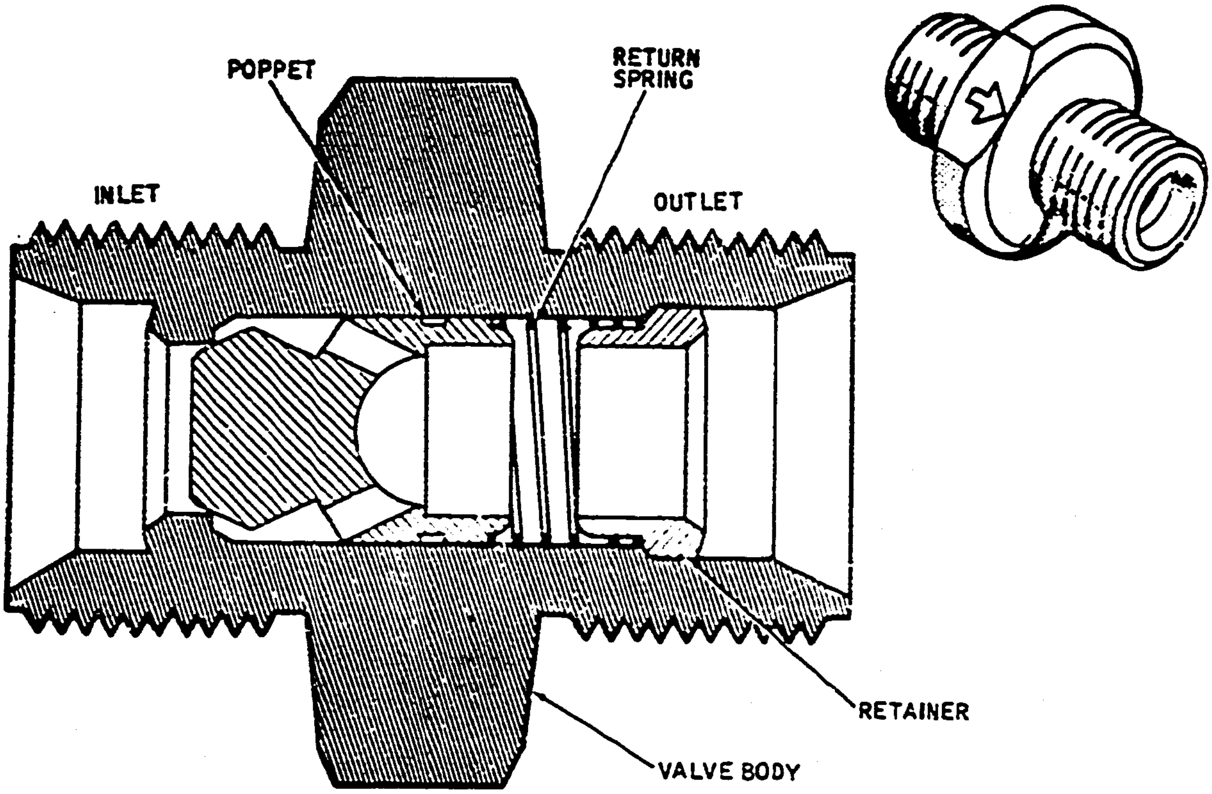
I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

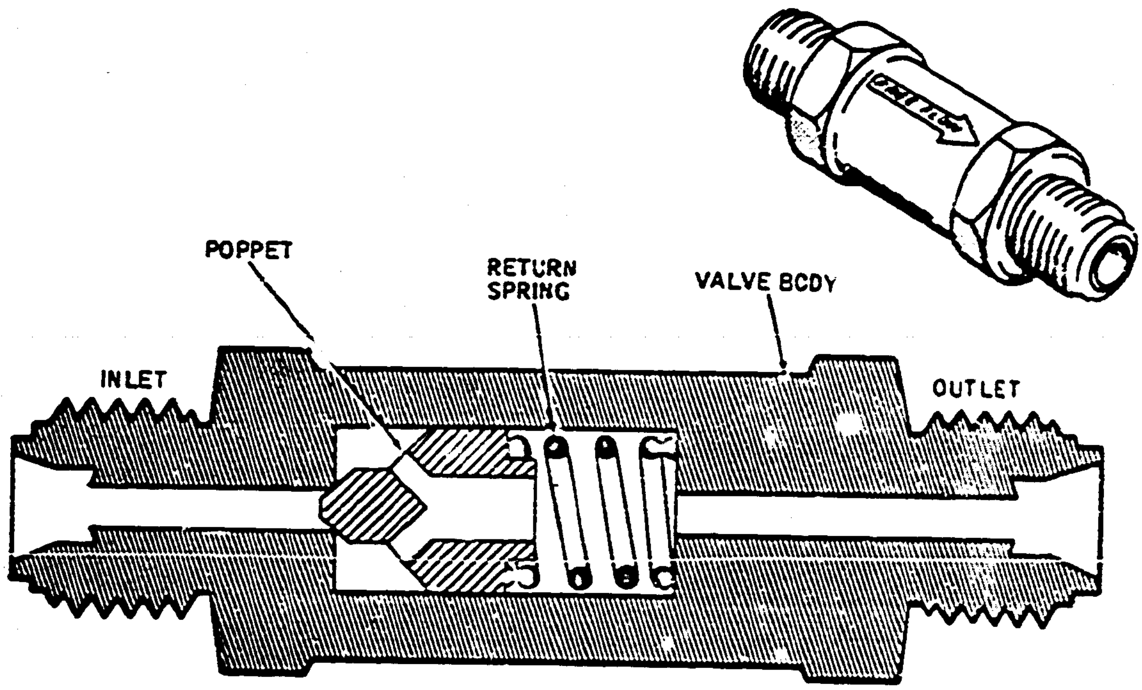
(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.



Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

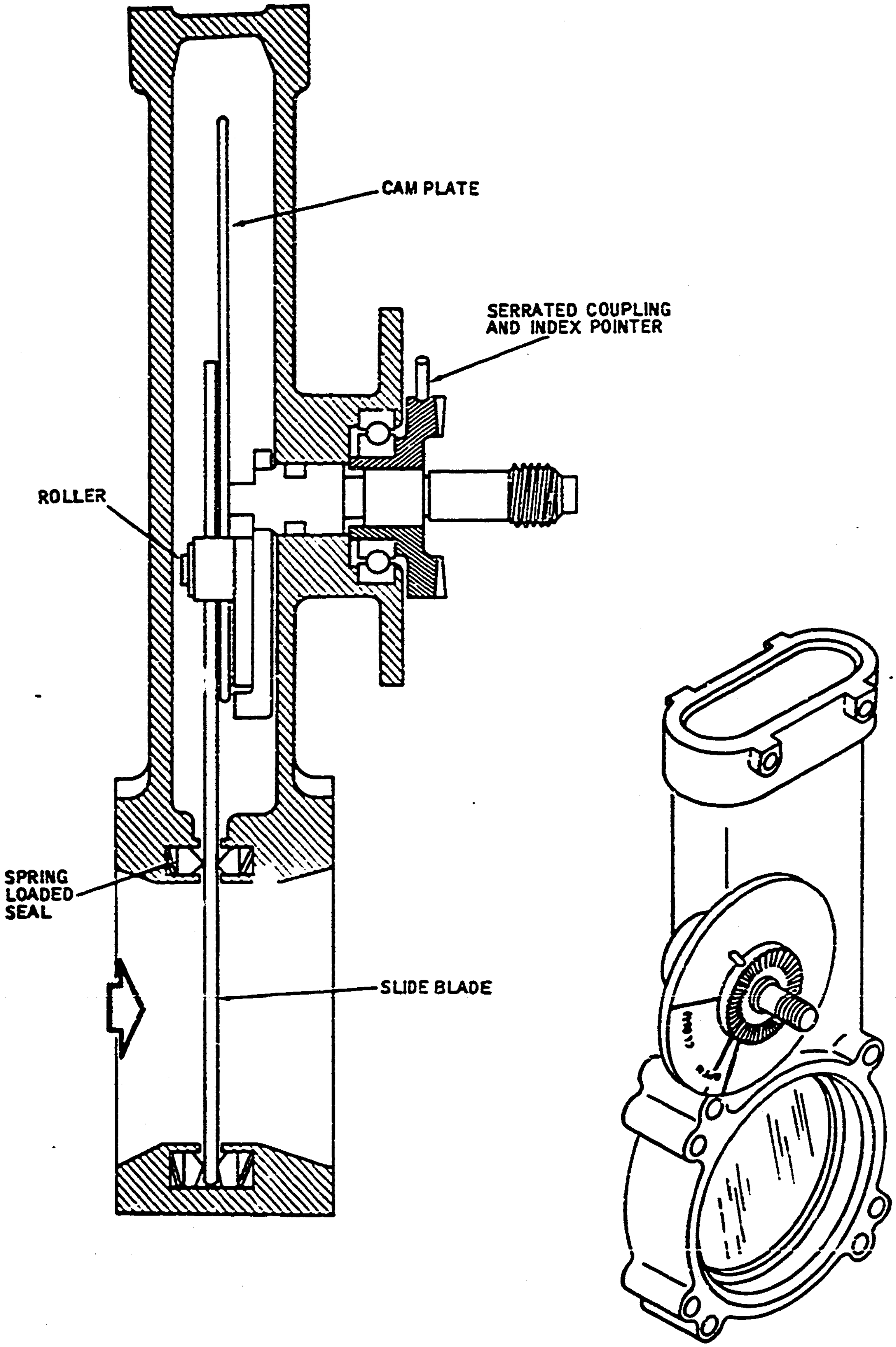
(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

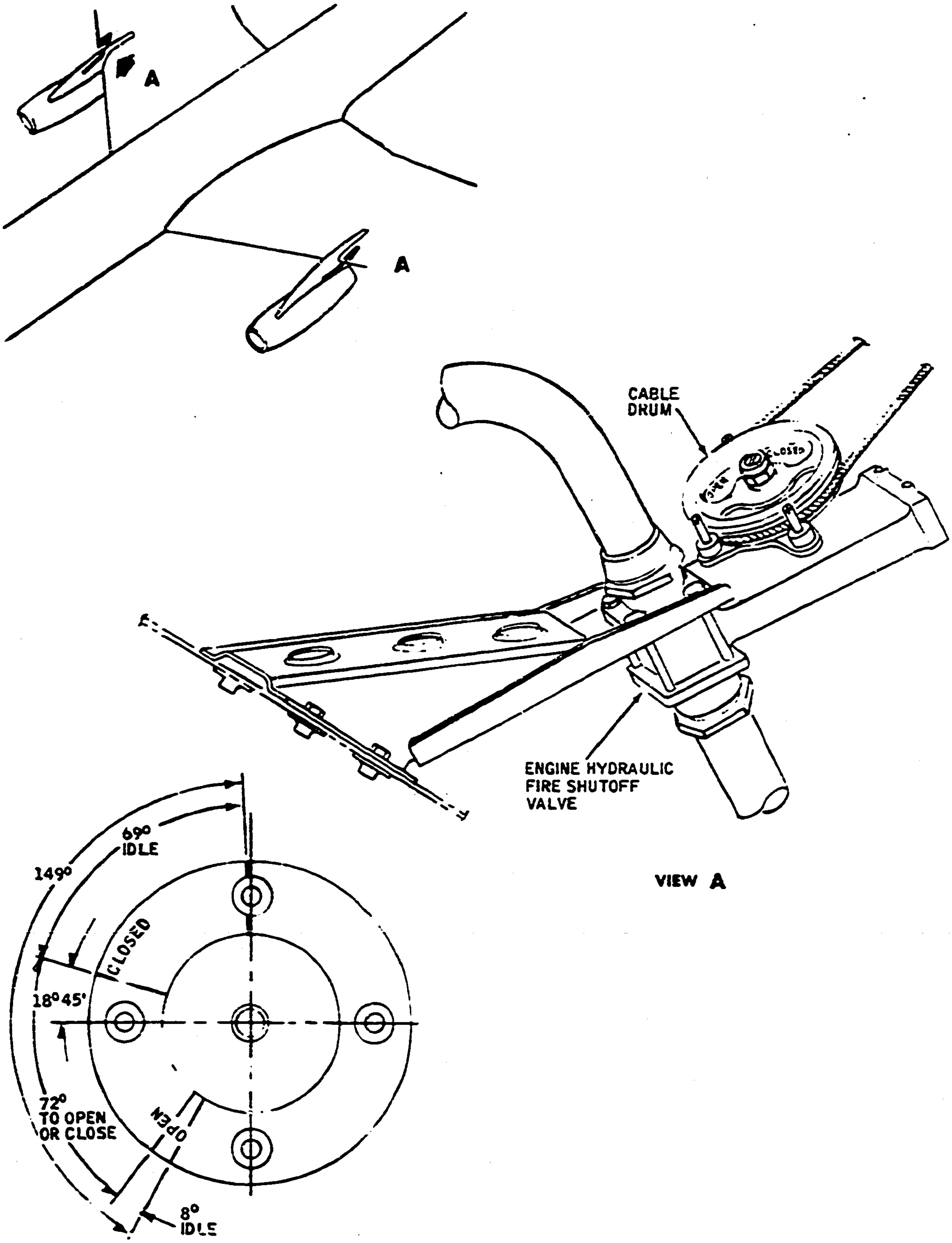
(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow to fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



HA2-22

Engine Hydraulic Fire Shutoff Valve
Figure 12

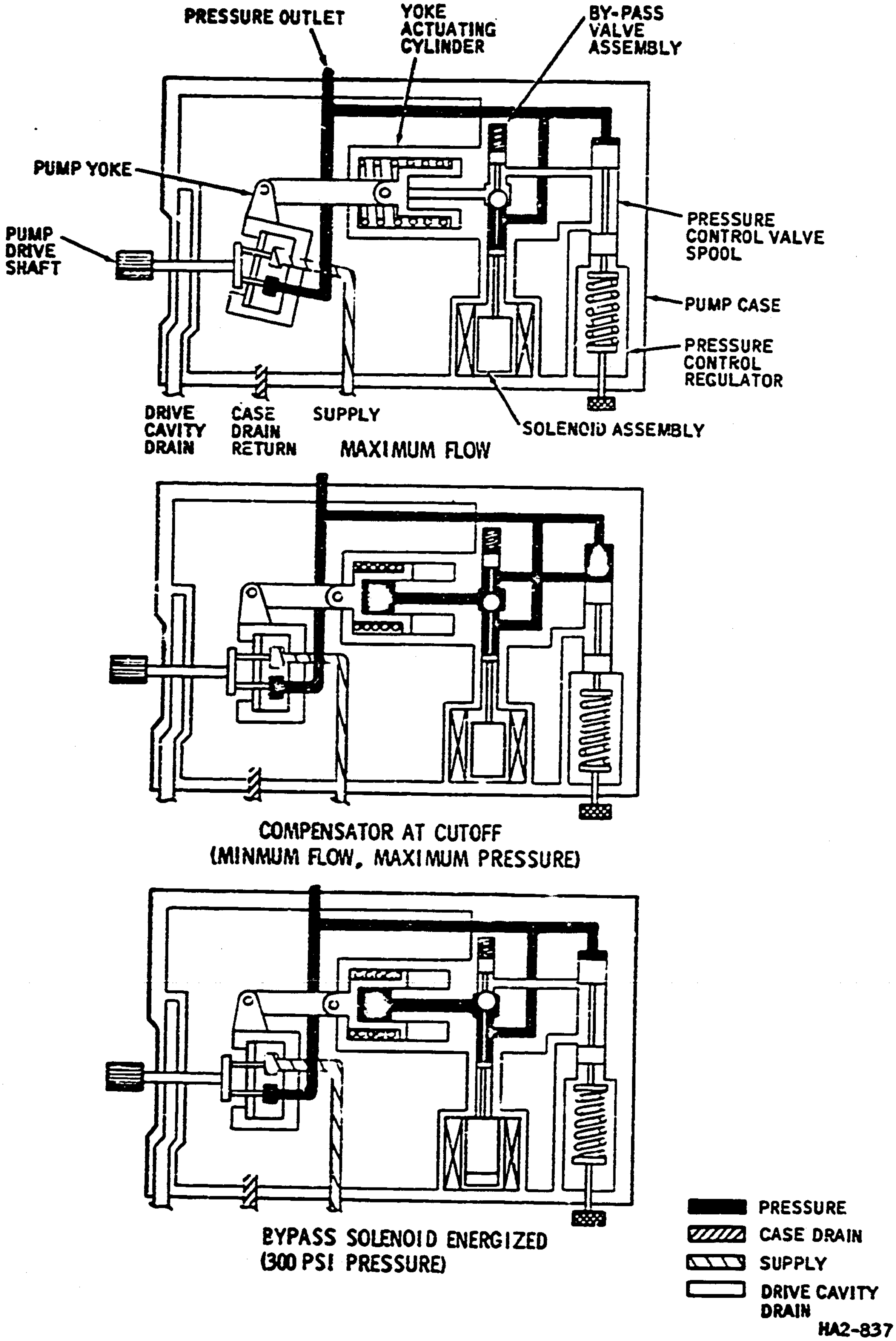
K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

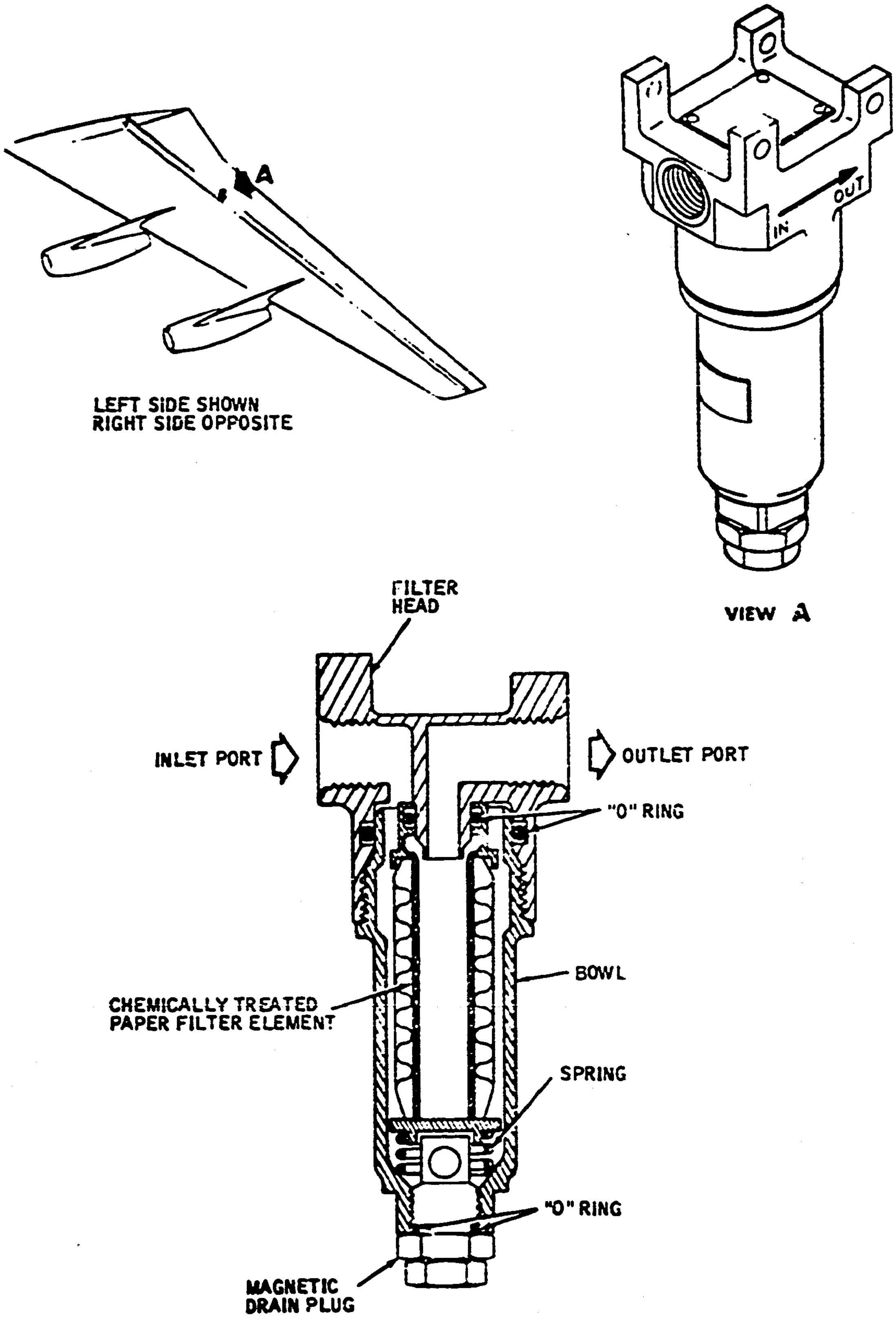
(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.



HA2-31

Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

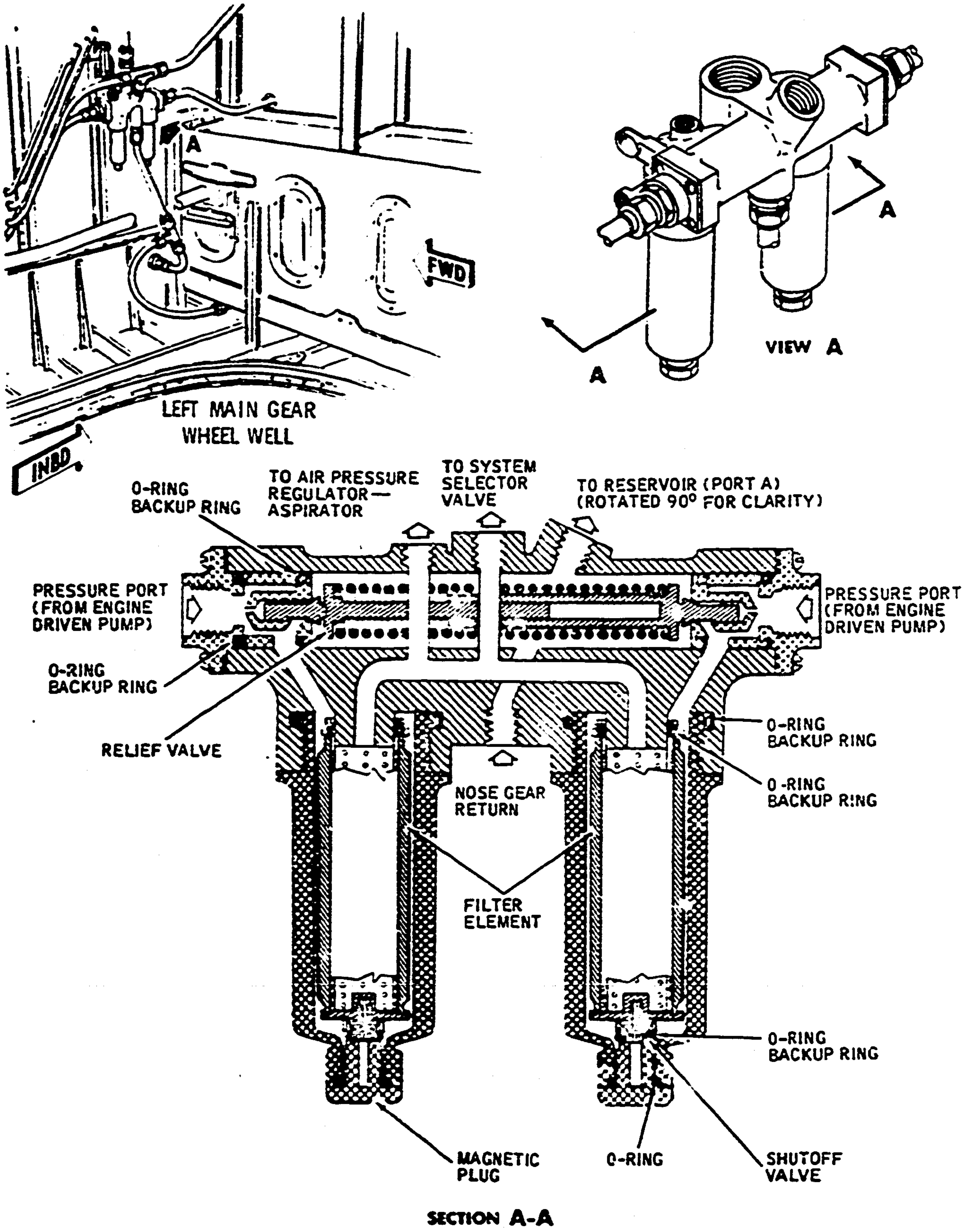
(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

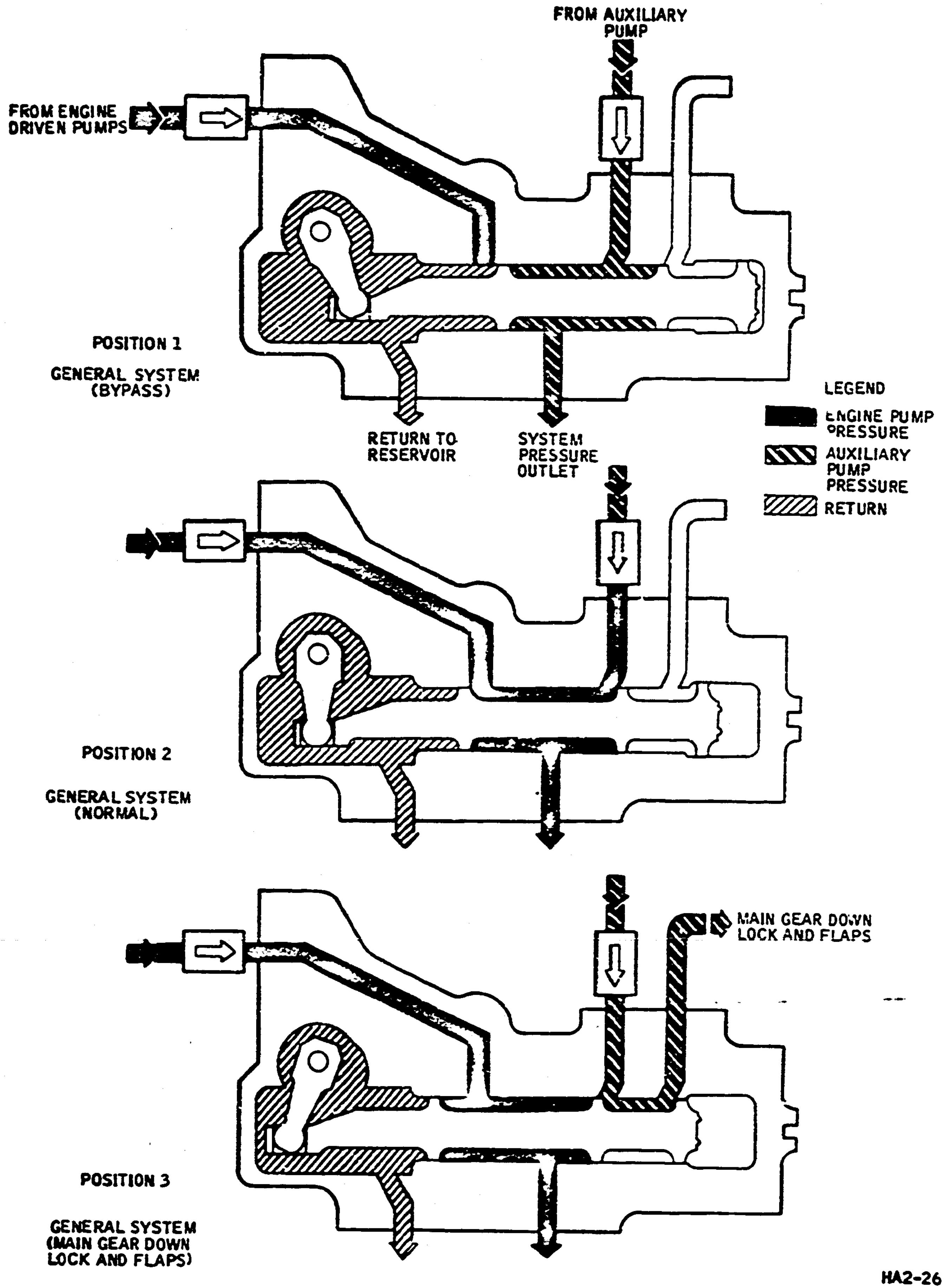
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

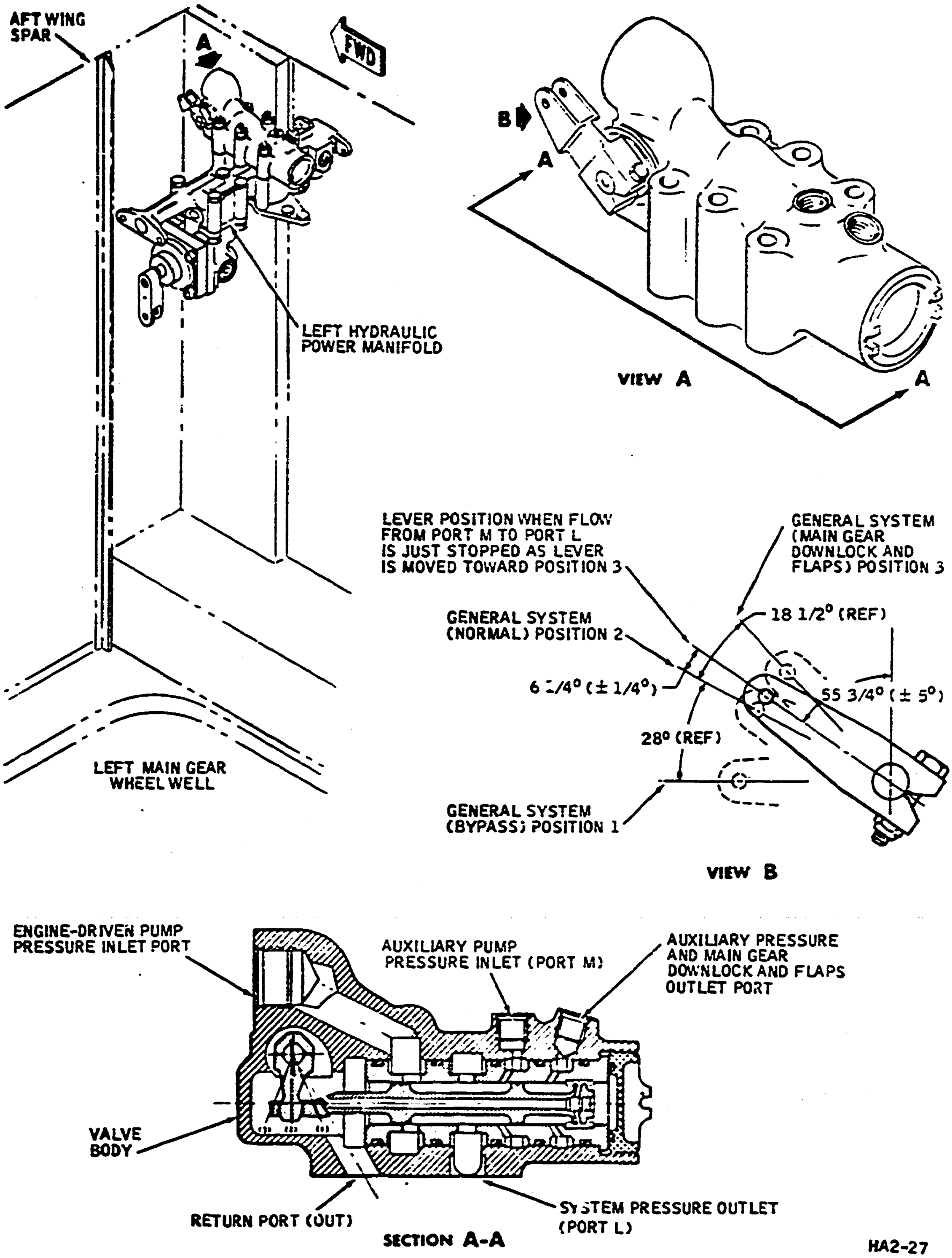


HA2-20

Dual Filter and Relief Valve -- Cutaway View
Figure 15



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, cau ing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

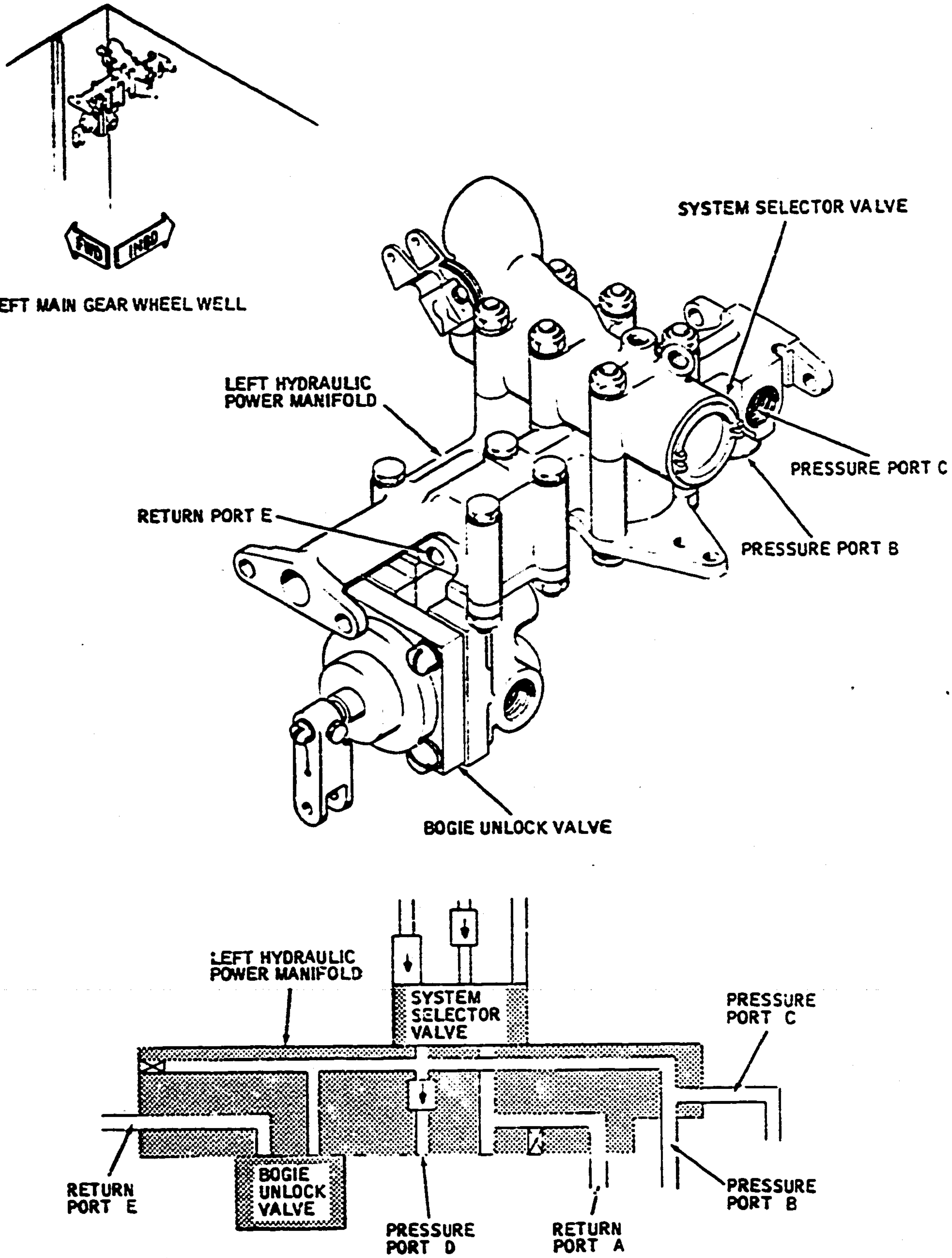
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

(2) Three valve-mounting pads are provided on the .fold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold pressure outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic



Left Hydraulic Power Manifold -- Schematic
Figure 18

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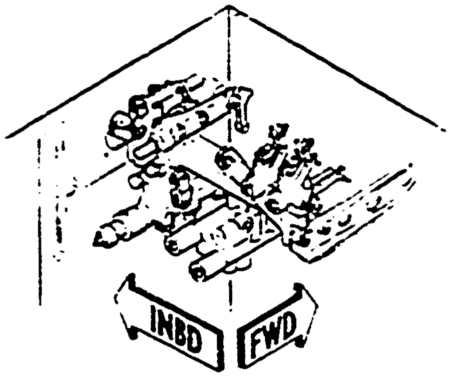
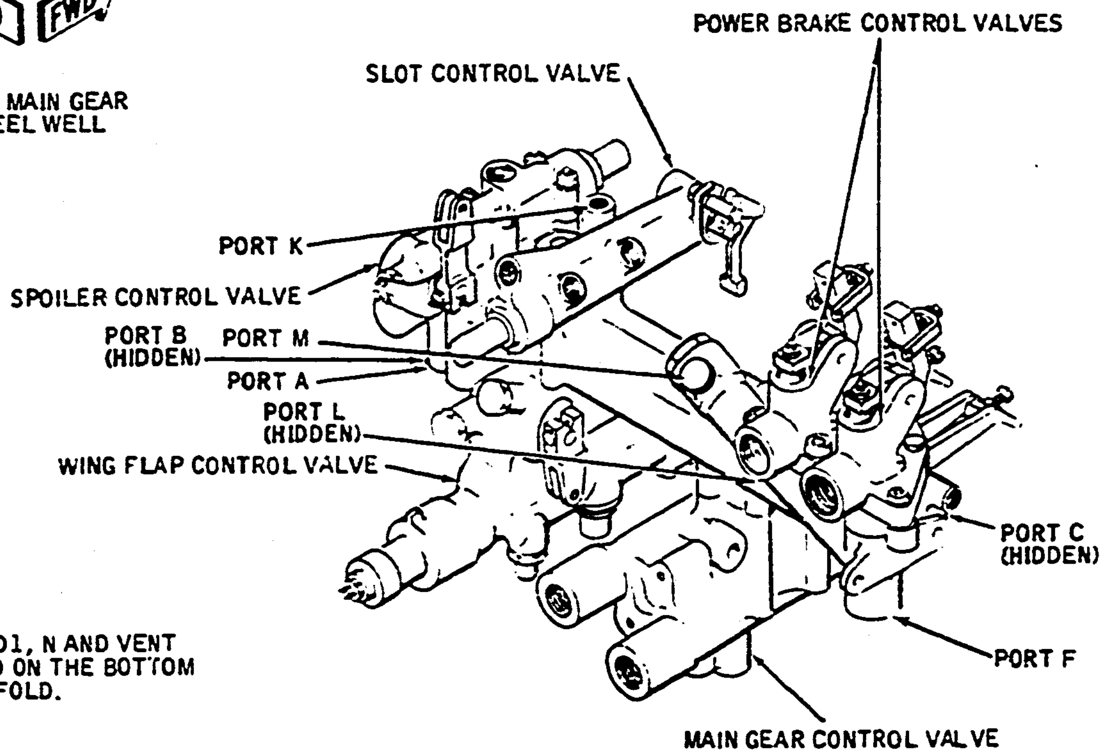
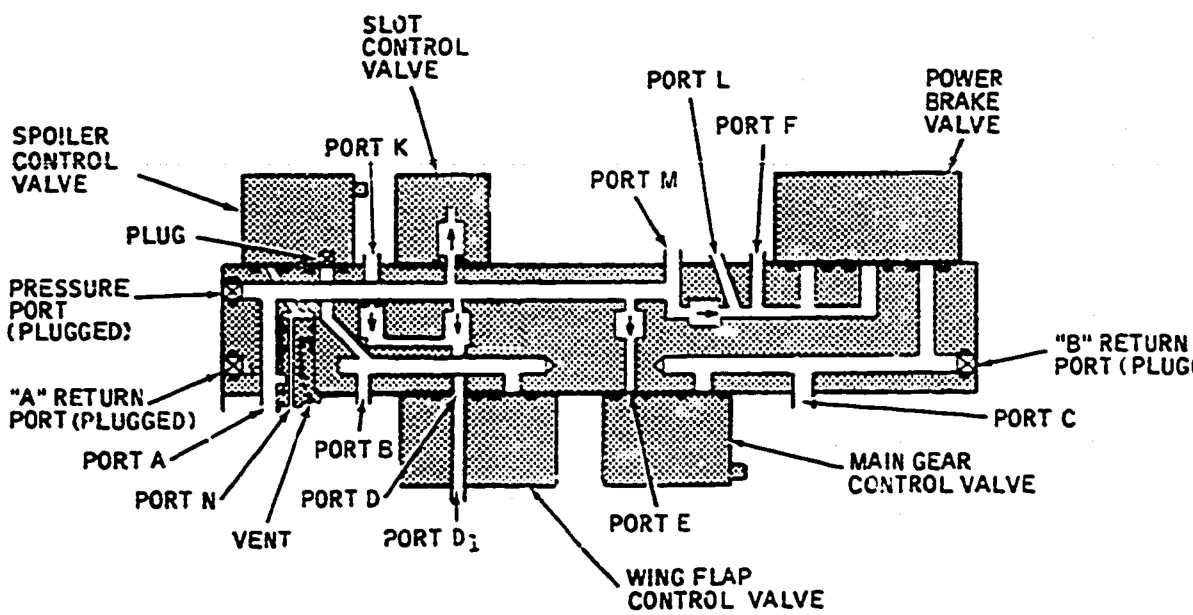


RIGHT MAIN GEAR
WHEEL WELL



NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19

subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Hydraulic Manifold Return Check Valves (See Figure 10.)

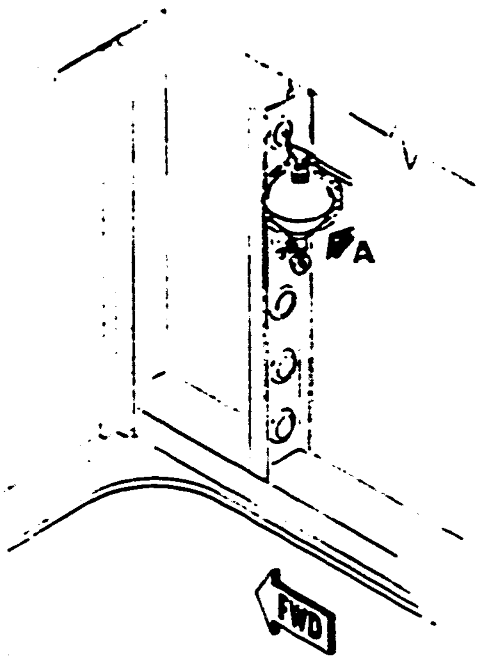
(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

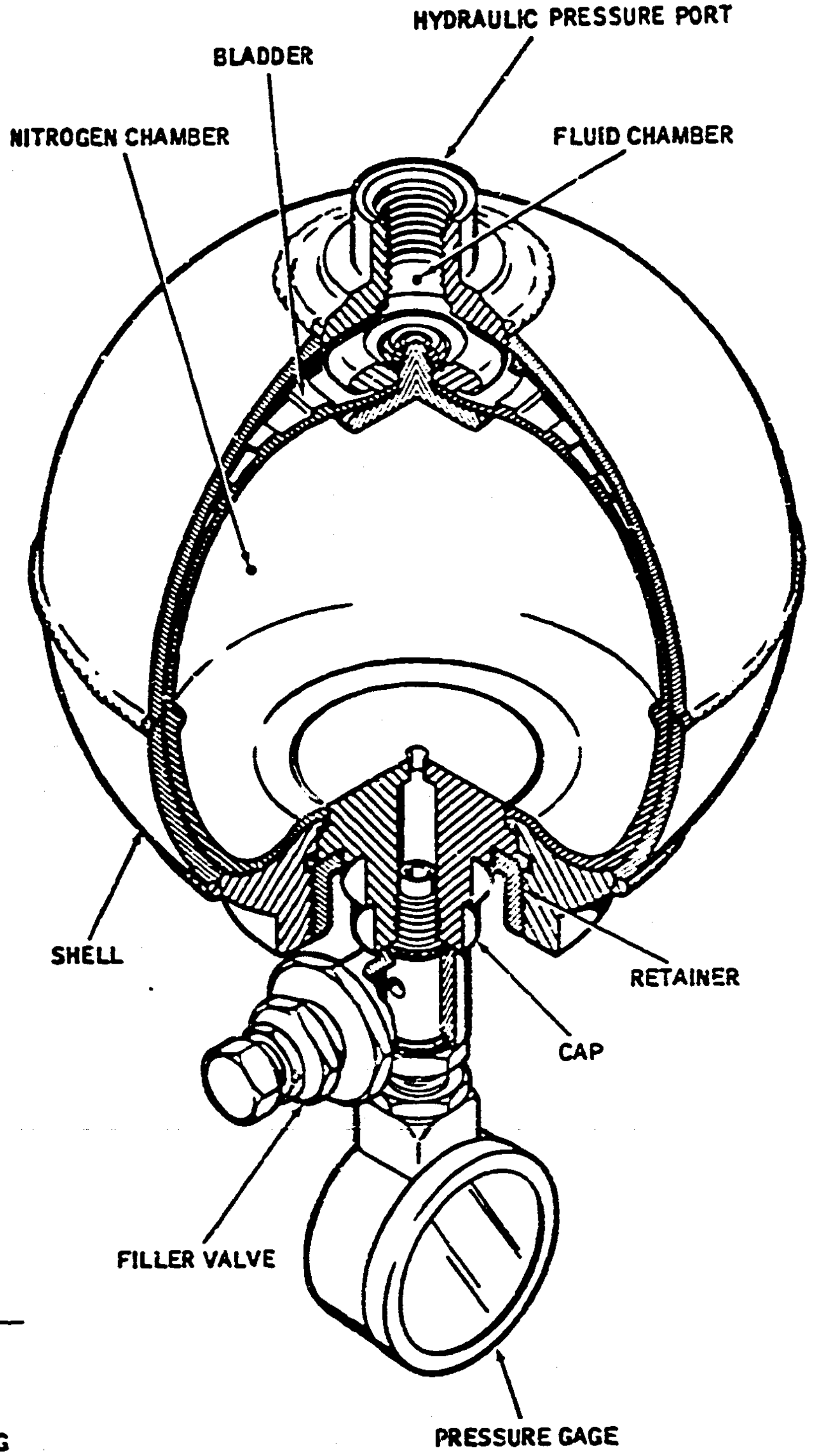
(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.

S. Hydraulic Power System Accumulator (See Figure 20.)

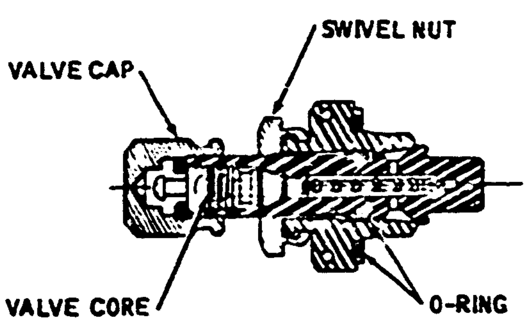
(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.





VIEW A



FILLER VALVE

HA2-30

Hydraulic Power System Accumulator --
Cutaway View
Figure 20

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

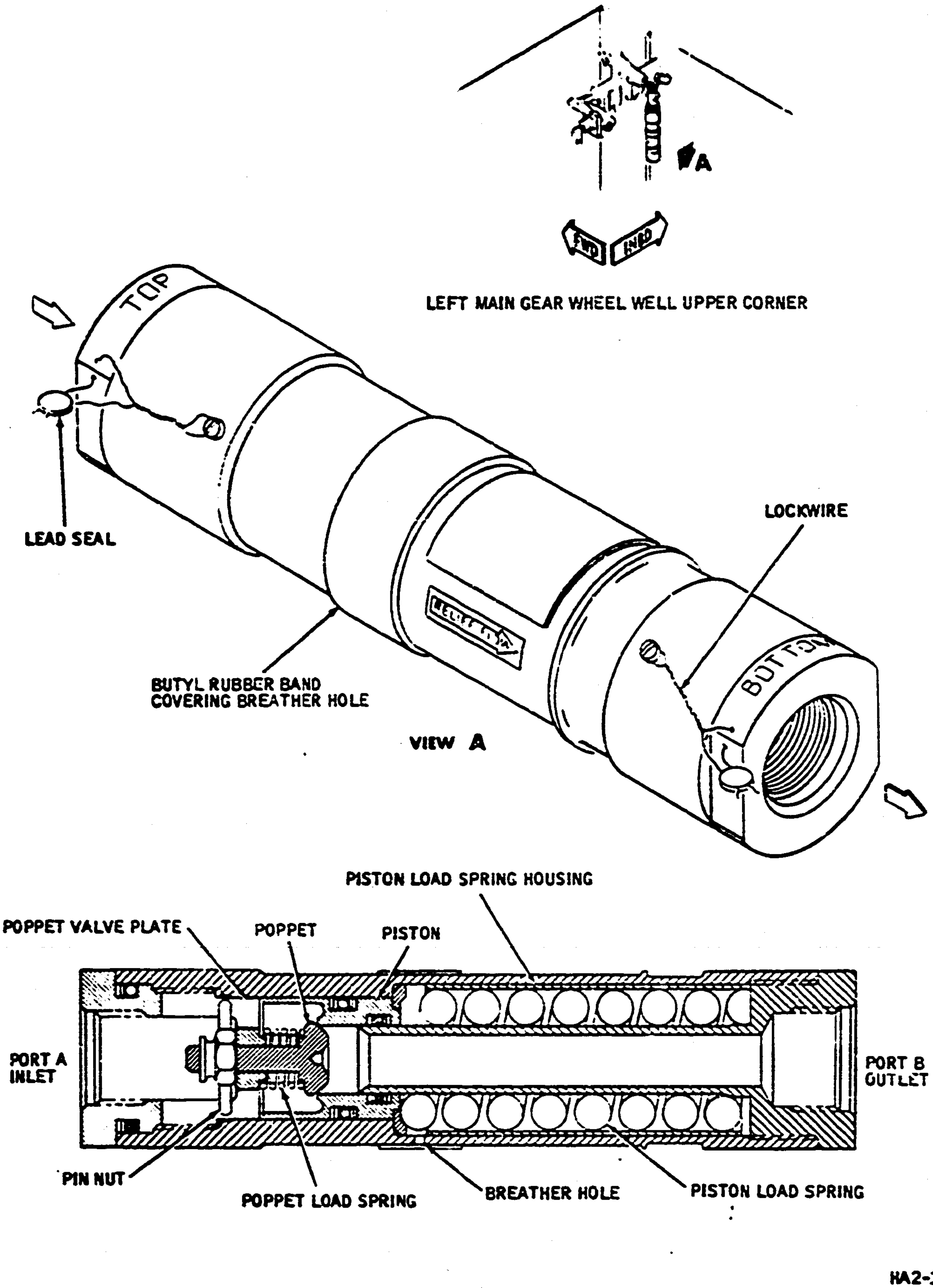
T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.



Hydraulic System Priority Valve -- Cutaway View
Figure 21

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the systen selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves

the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to theauxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

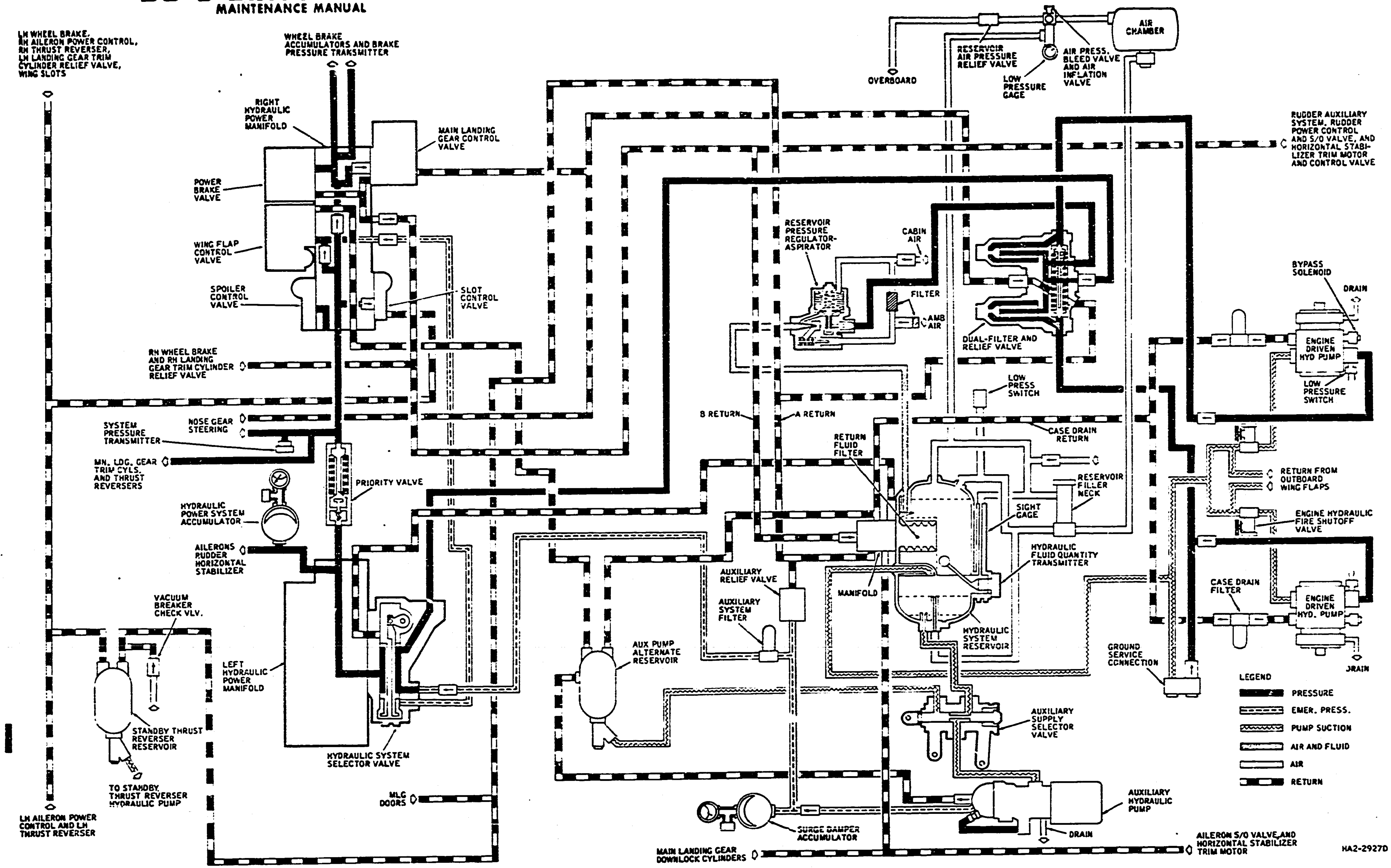
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

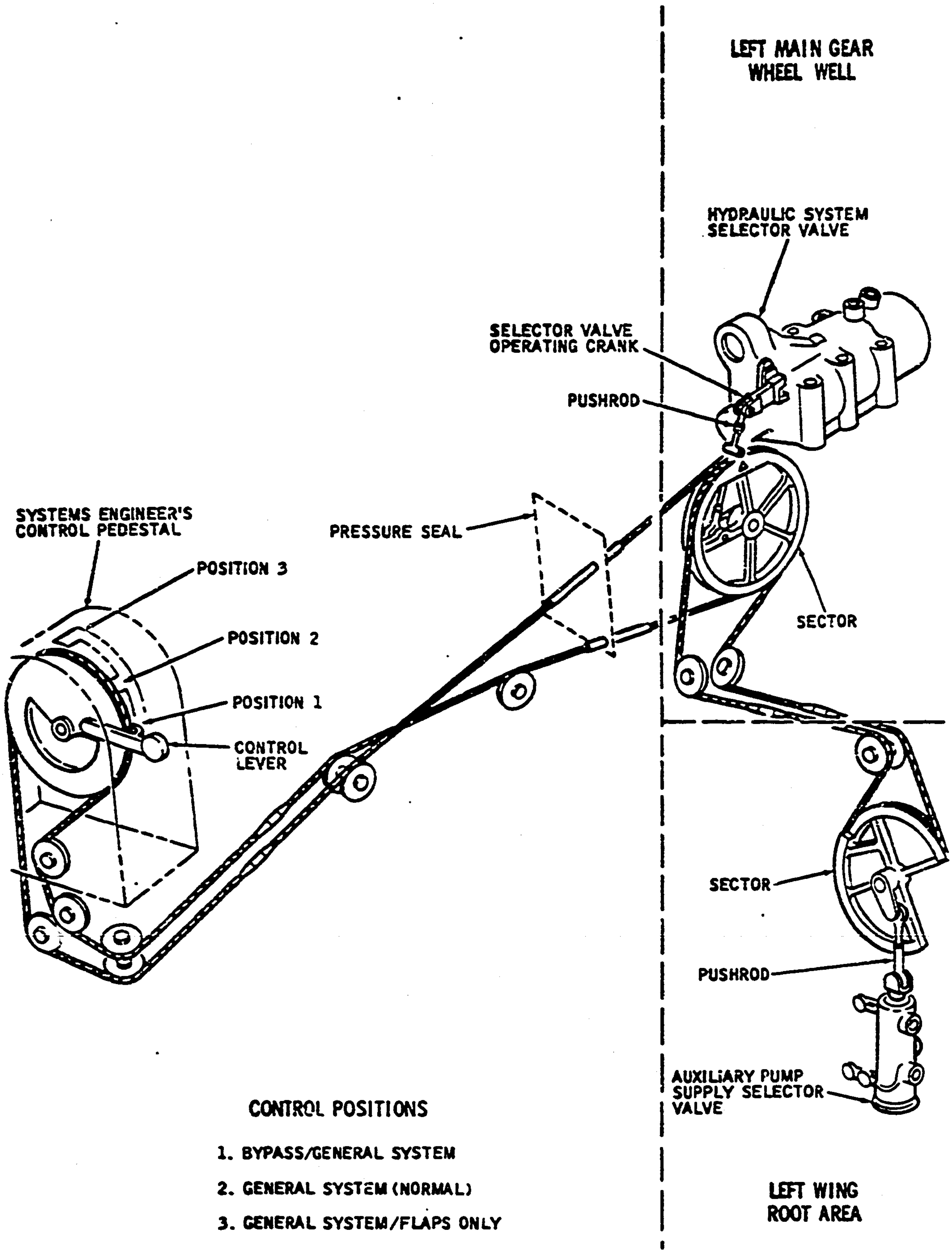
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram
Figure 1



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

back to the reservoir via a return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff.

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake.

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/flaps only position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/flaps only position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

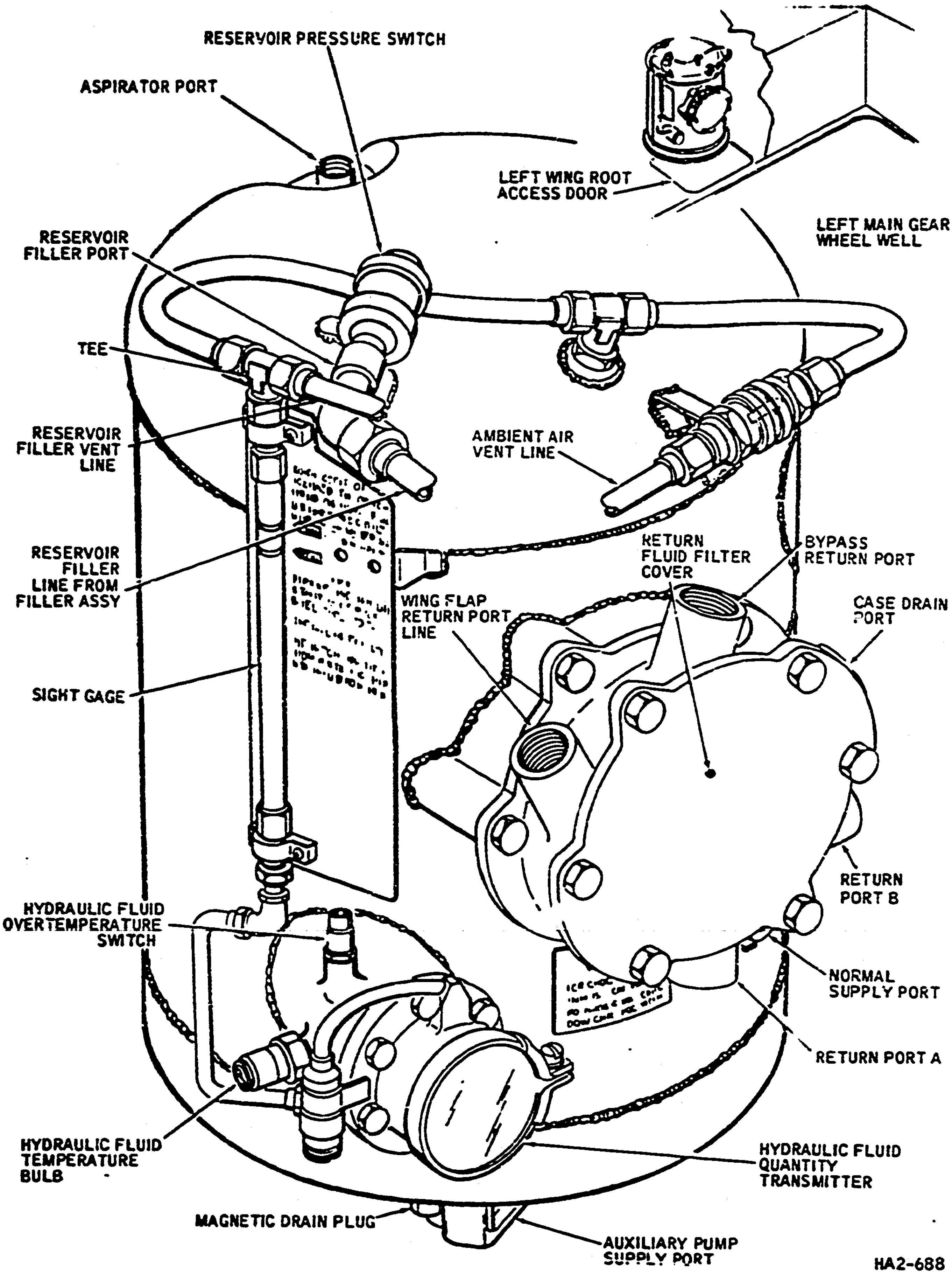
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/flaps only position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve. Engine-driven pump pressure is ported from the system selector valve to the general system.

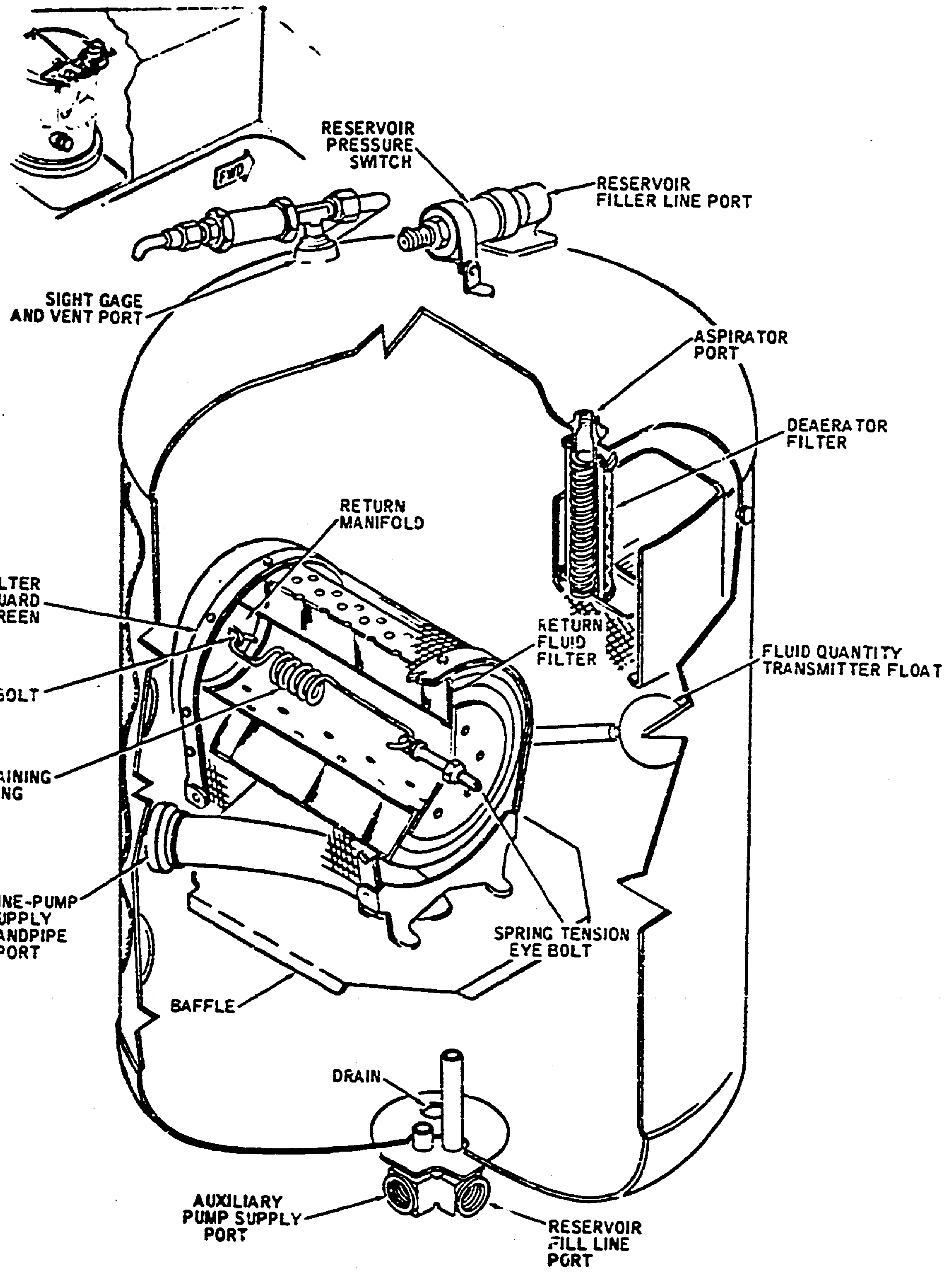
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.



Hydraulic System Reservoir -- External View
Figure 3



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Hydraulic System Reservoir -- Cutaway View
Figure 4

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

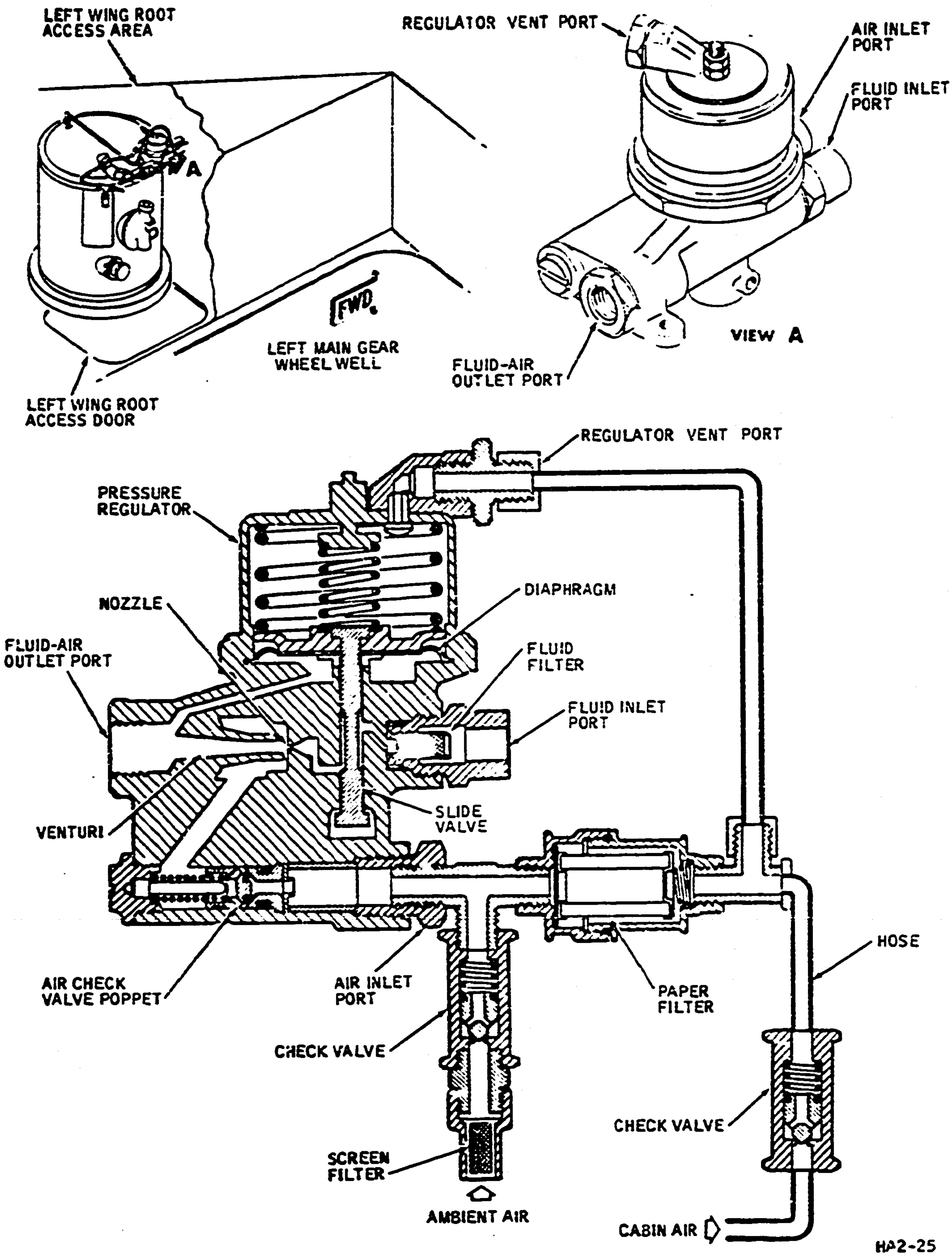
(3) Internally, the filter has a 10-micron, resin-impregnated convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

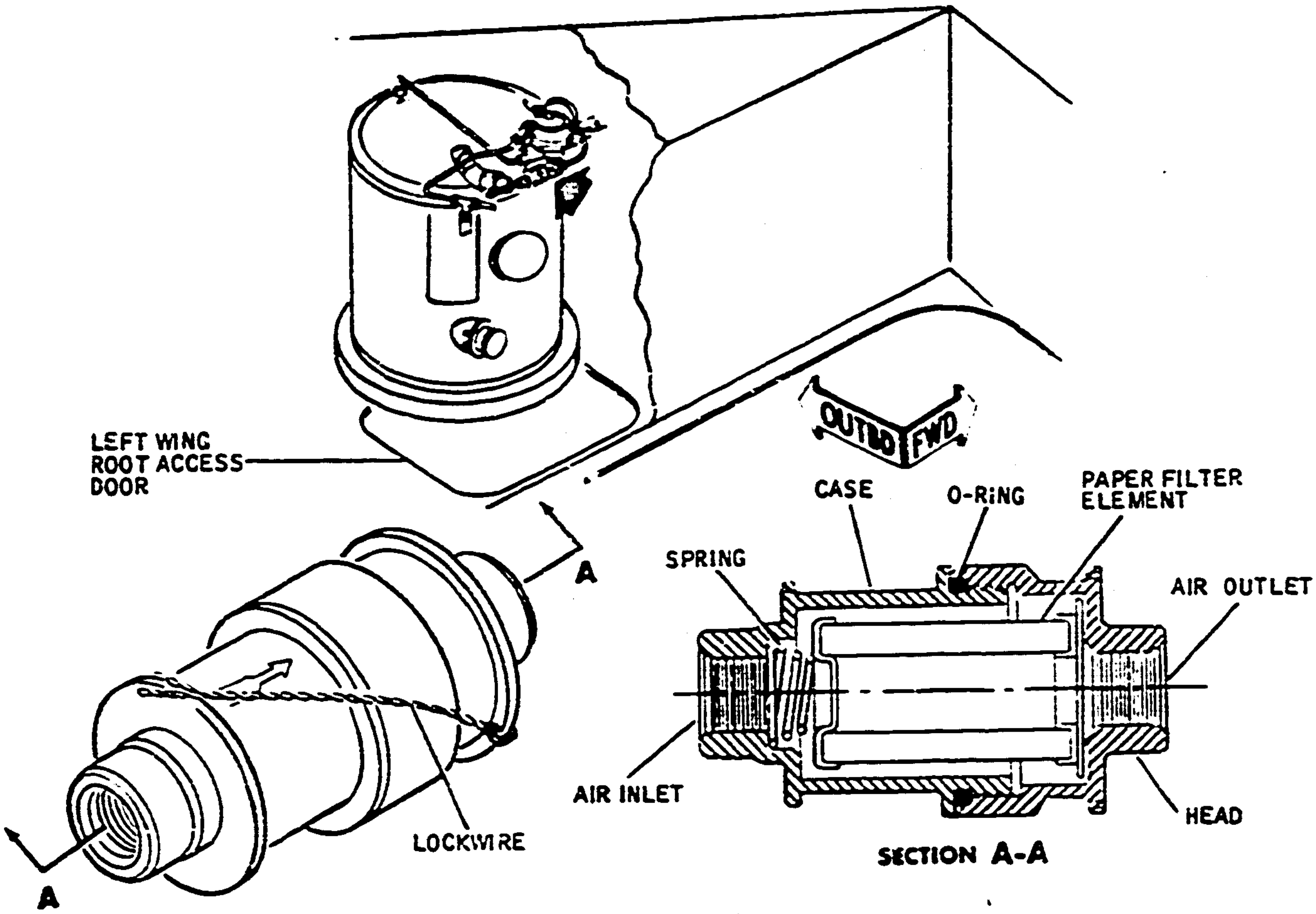
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

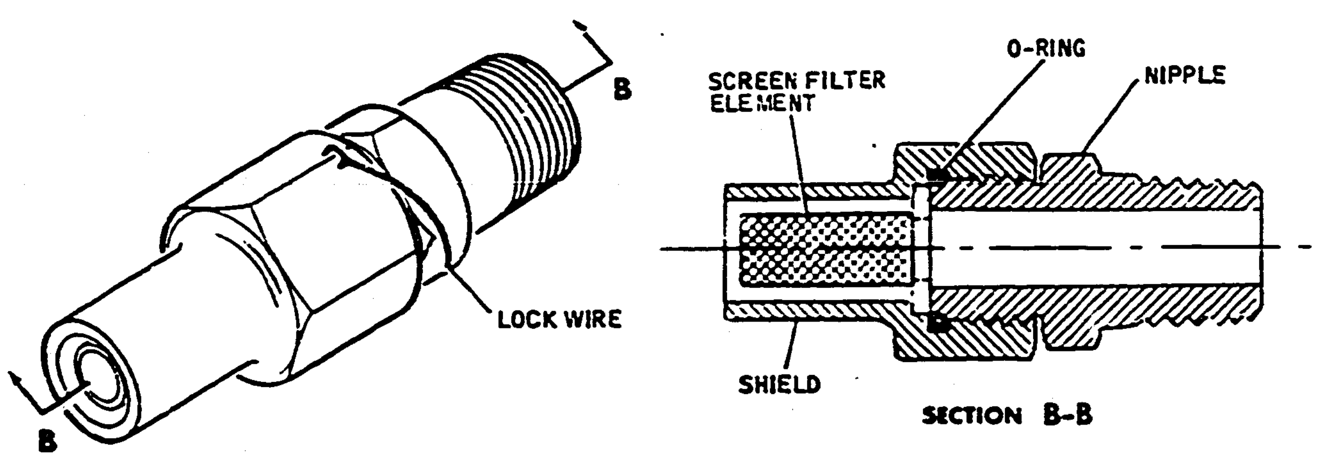
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.



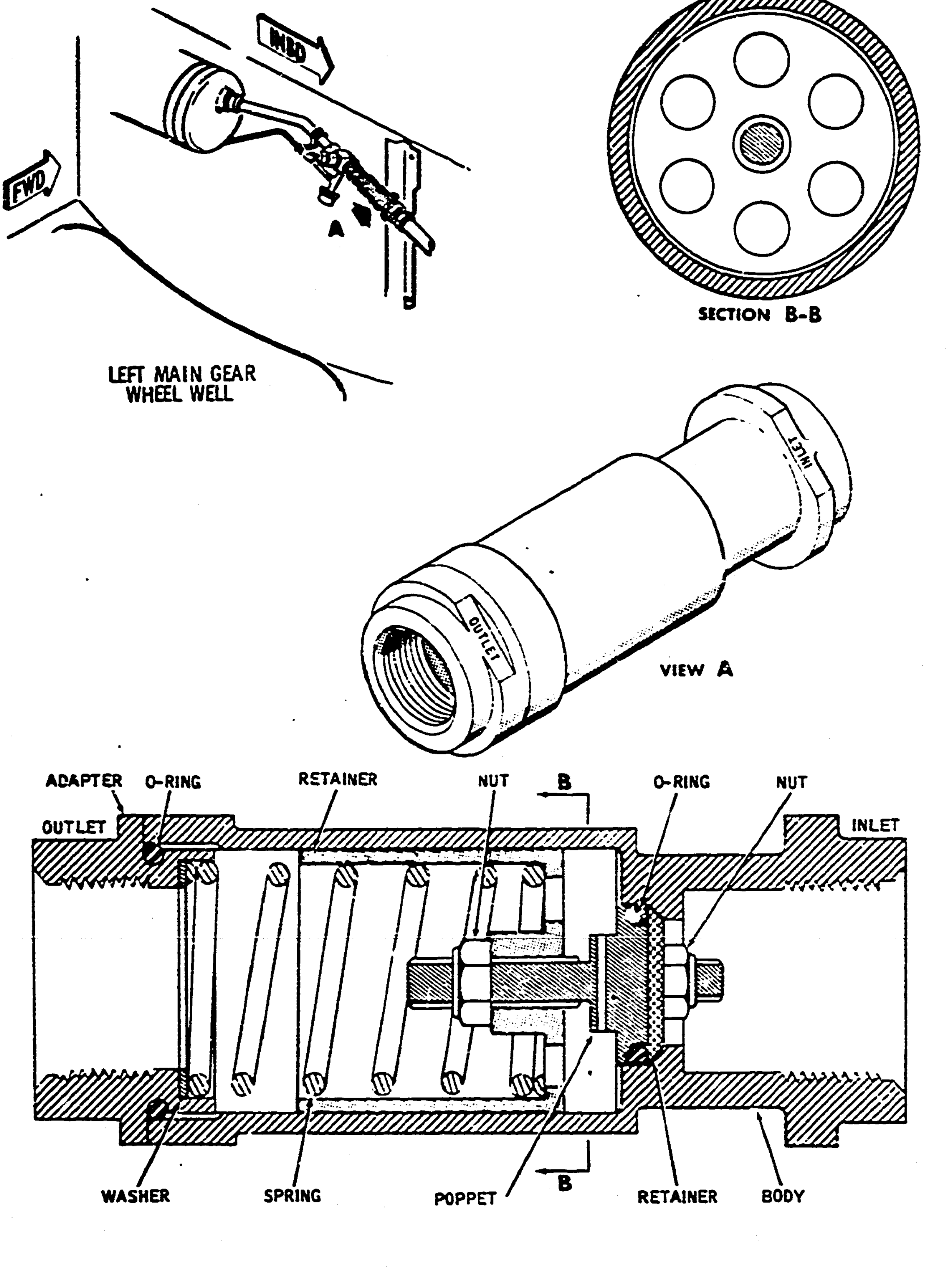
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



Hydraulic Reservoir Relief Valve
Figure 7

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

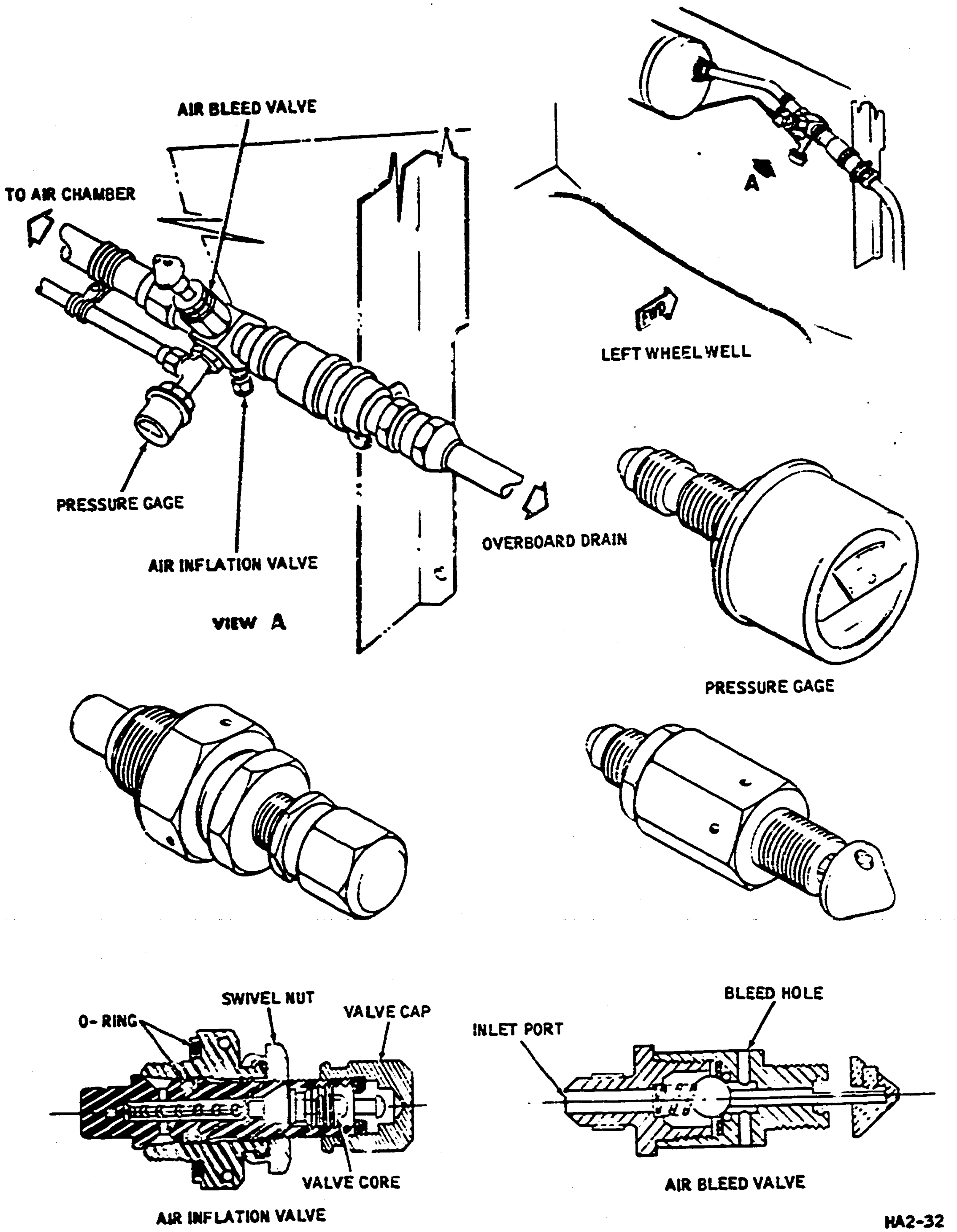
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

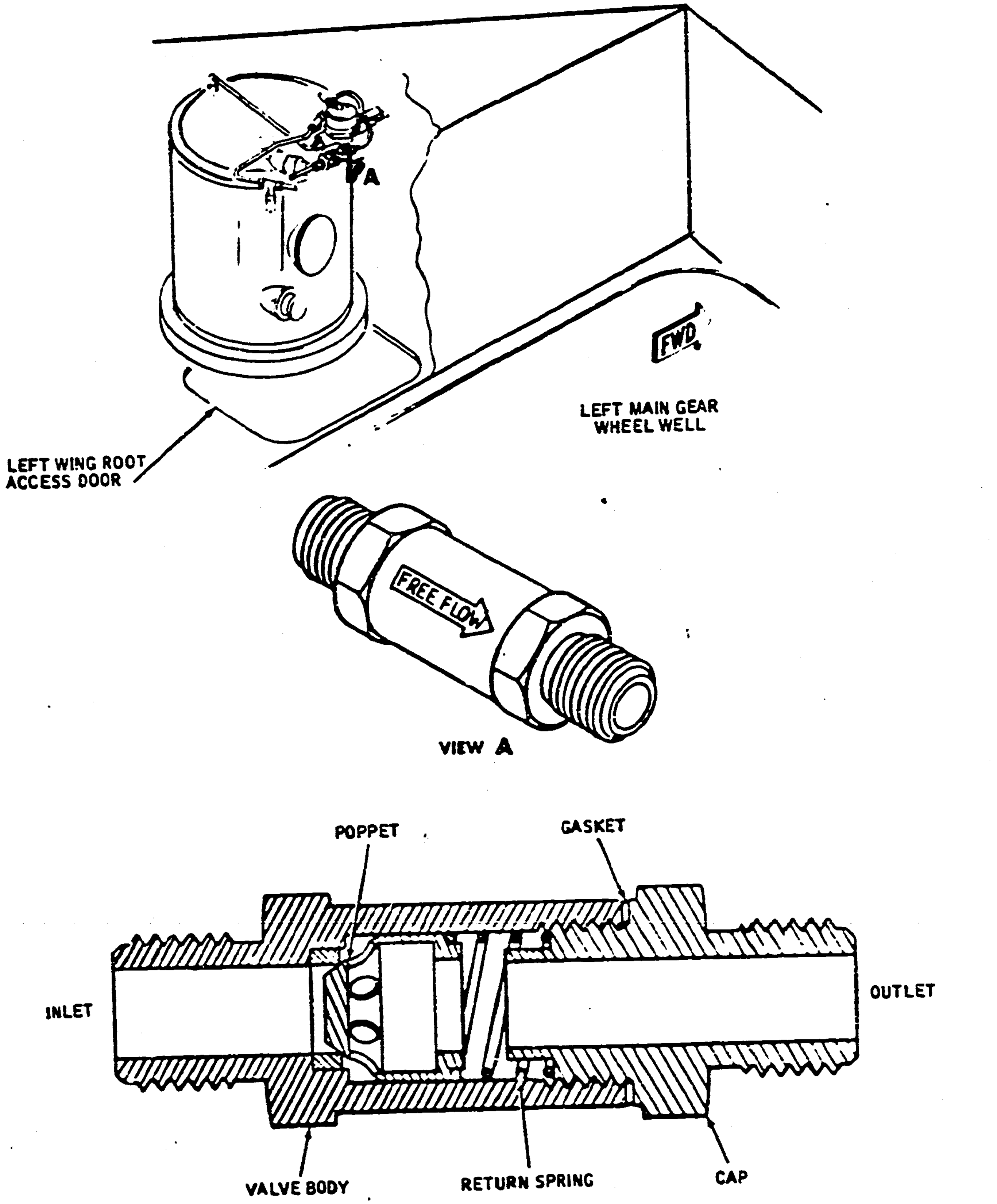
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

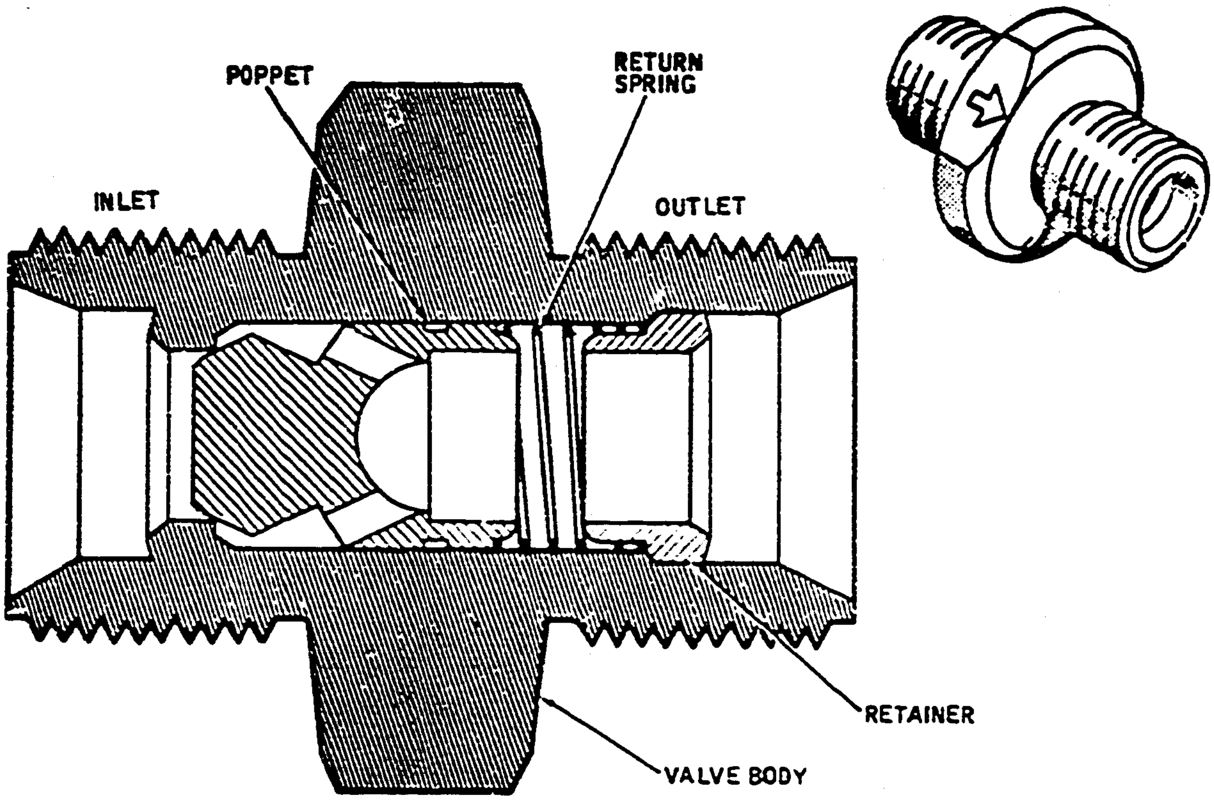
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

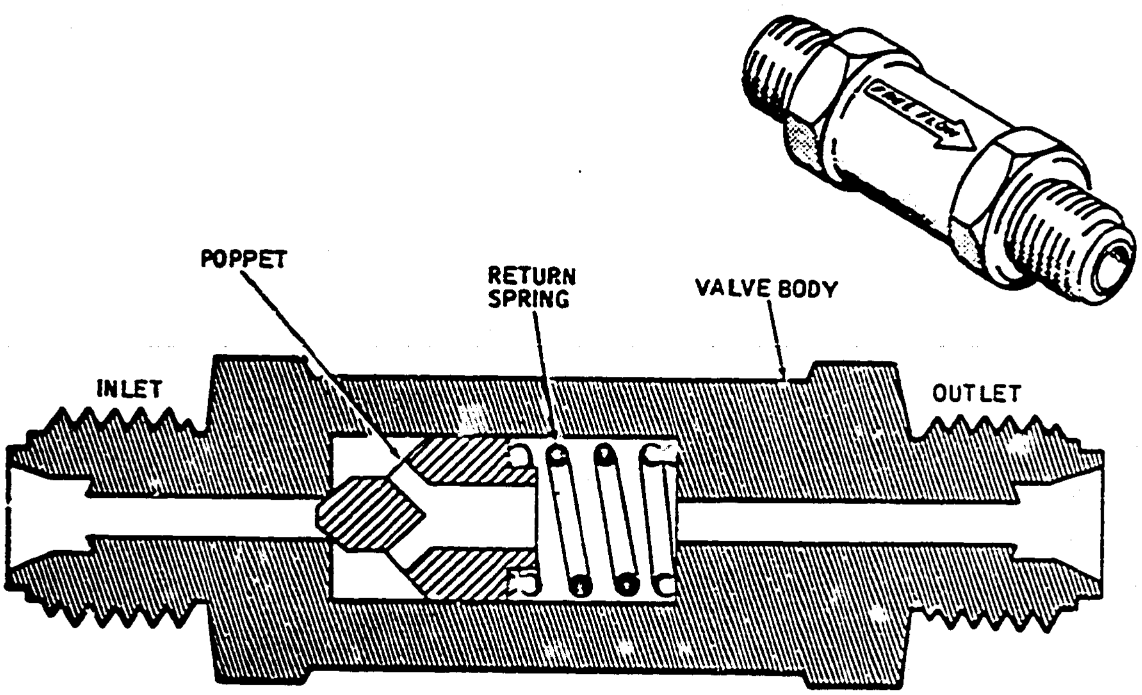
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

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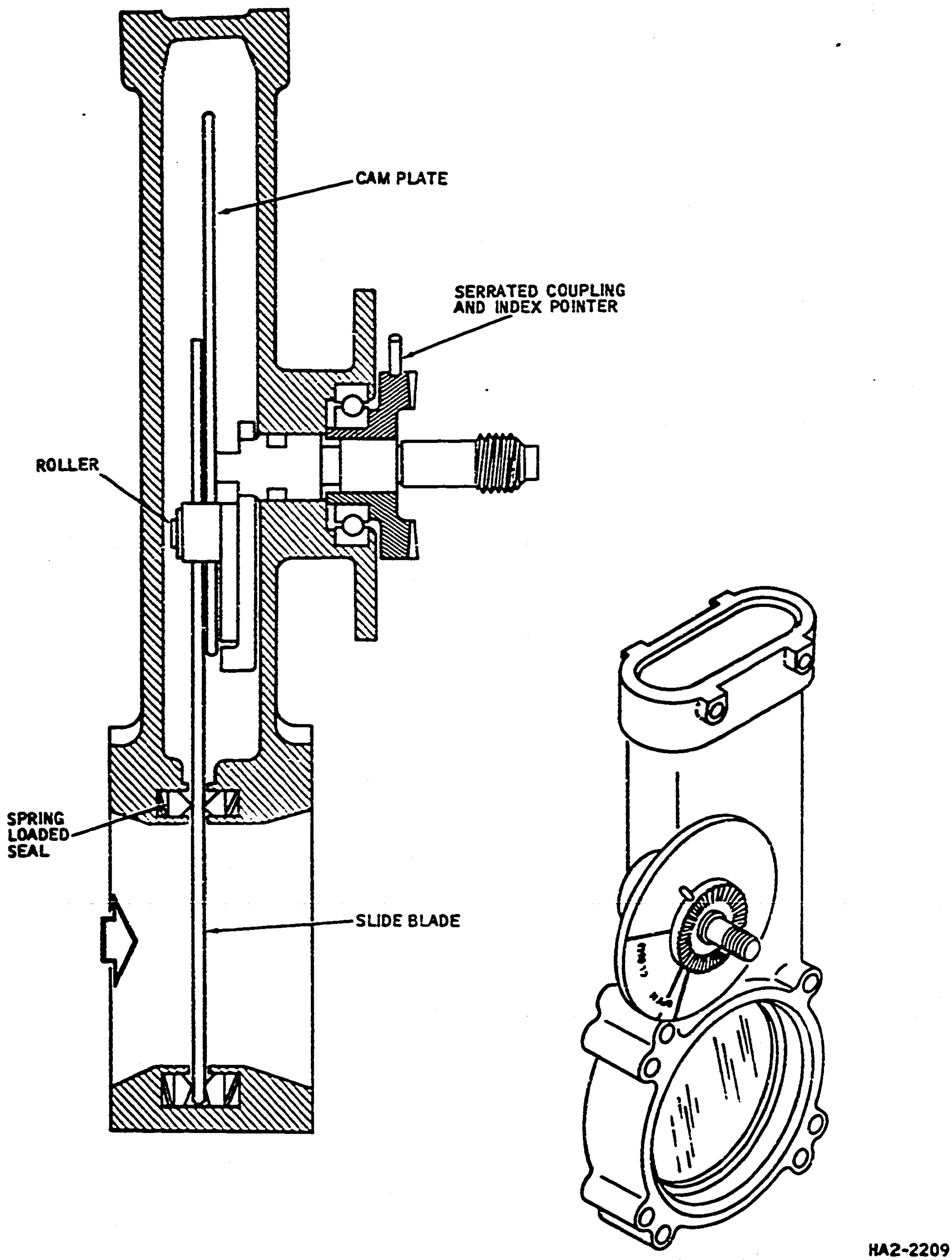
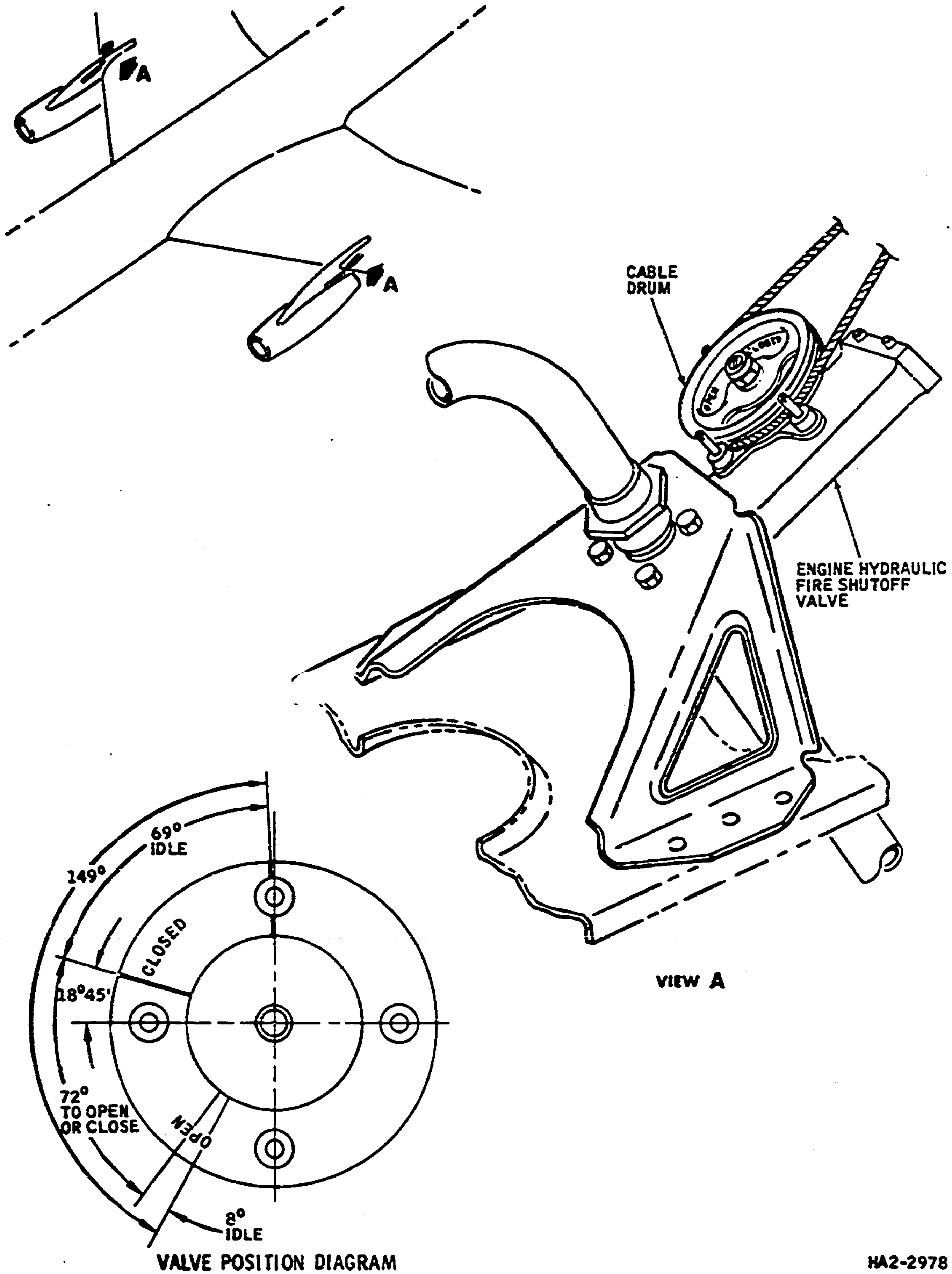
Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

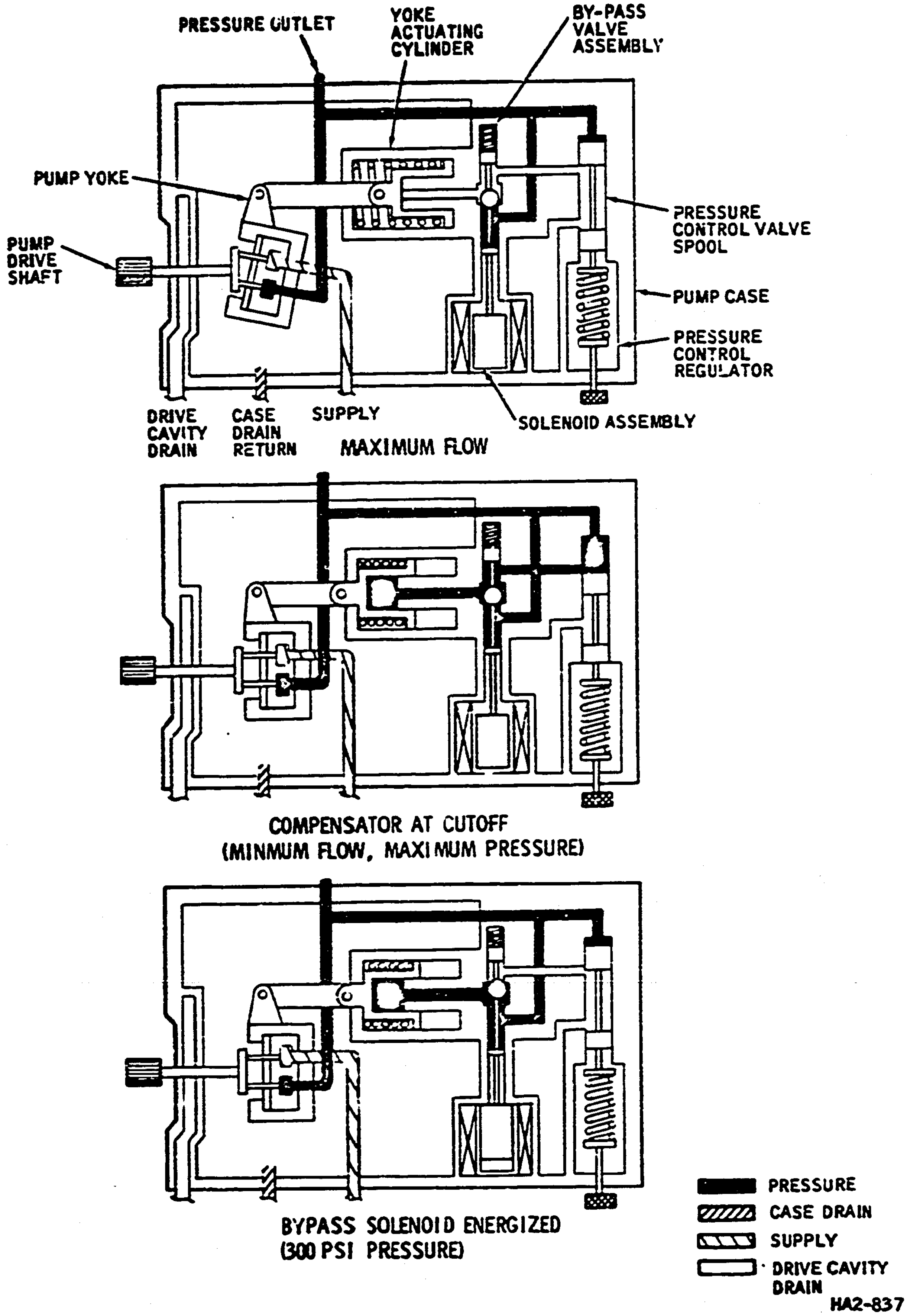
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is



Engine-Driven Hydraulic Pump Pressure - Flow -- Schematic
Figure 13

provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulators meter the pressure to the yoke control piston, which position the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. If the engine-driven hydraulic pump control switches are in the on position, and the output pressure of either pump drops below 1500 psi, an amber indicating light located in the flight compartment comes on.

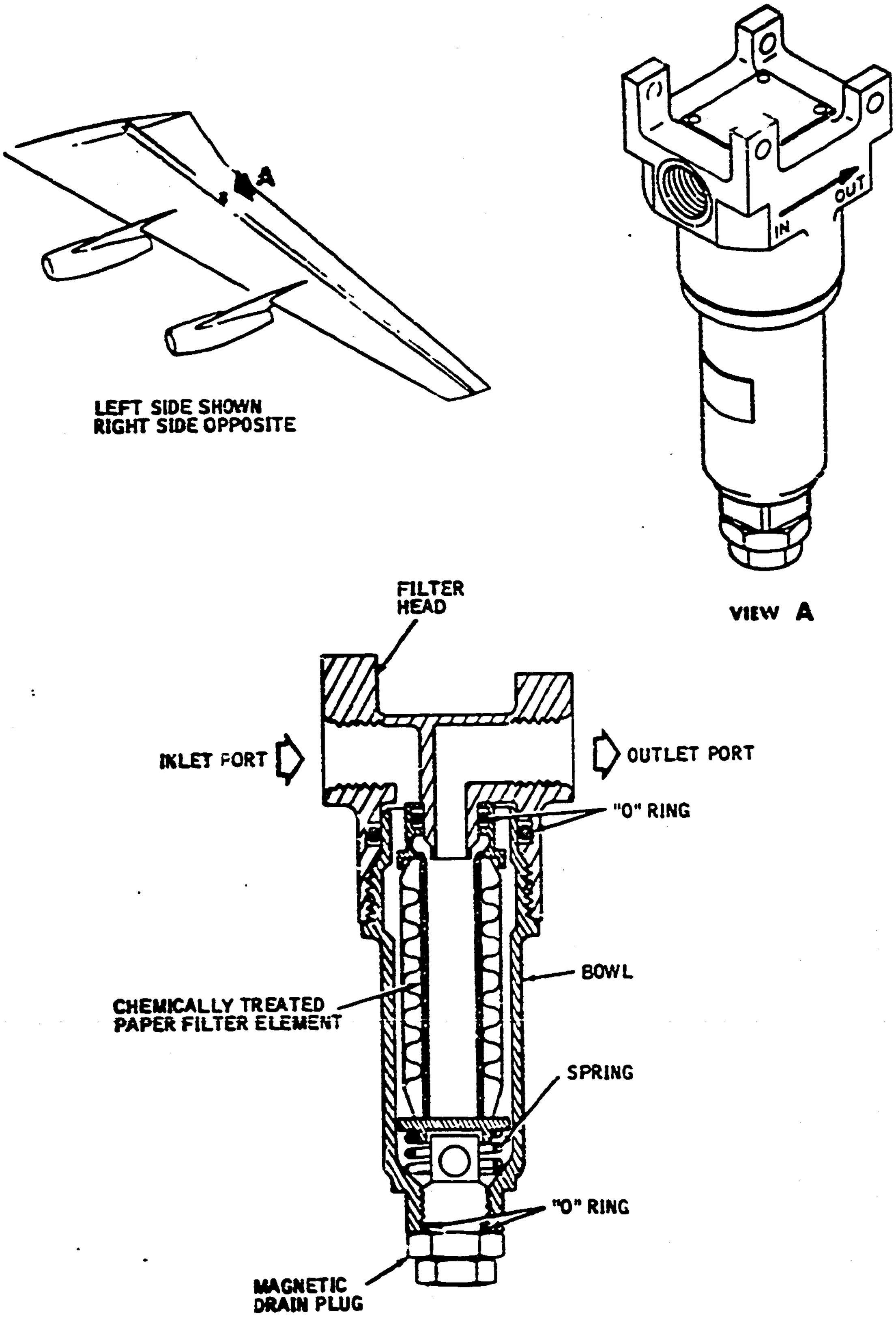
L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by



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Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

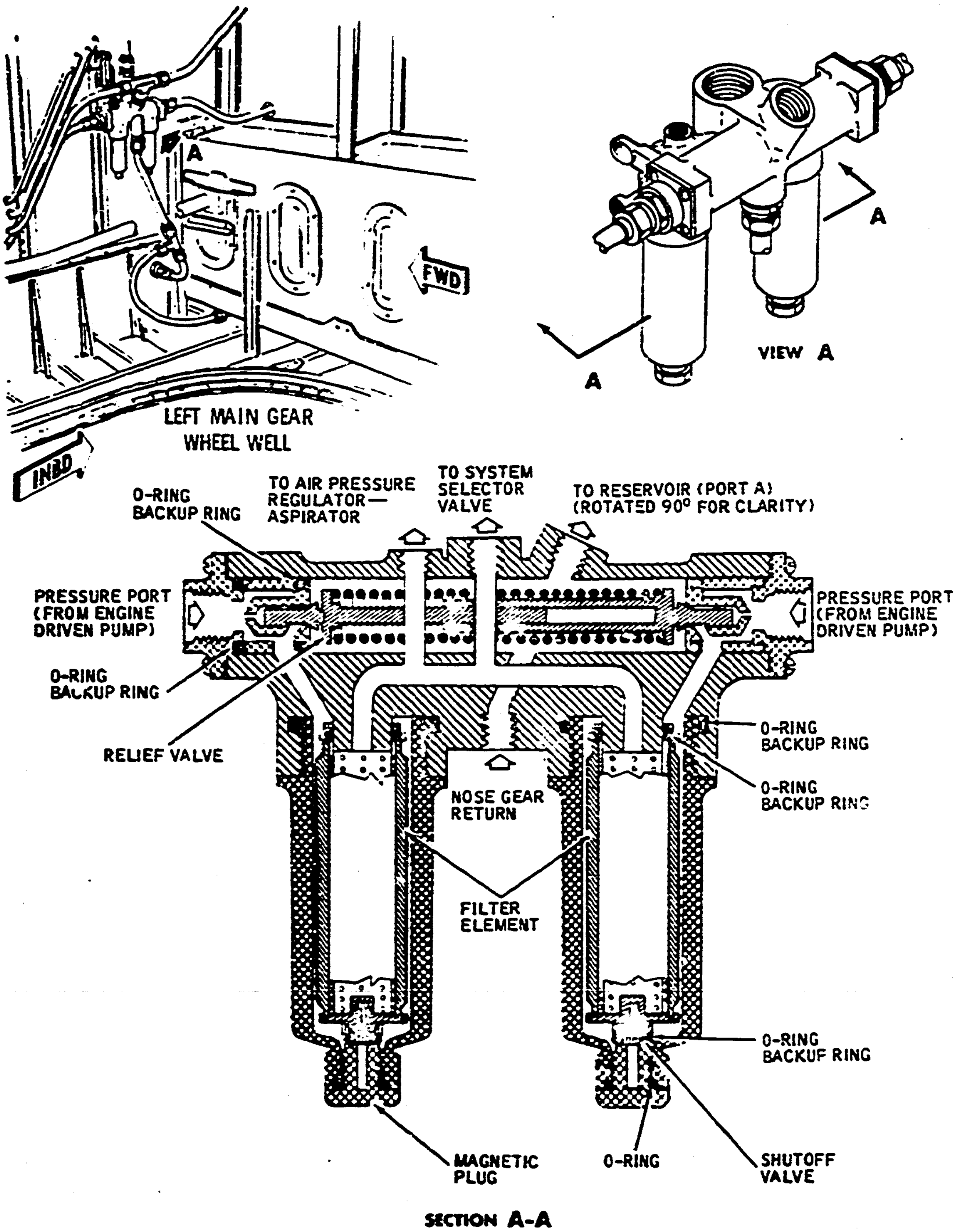
(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3000 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow or pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.



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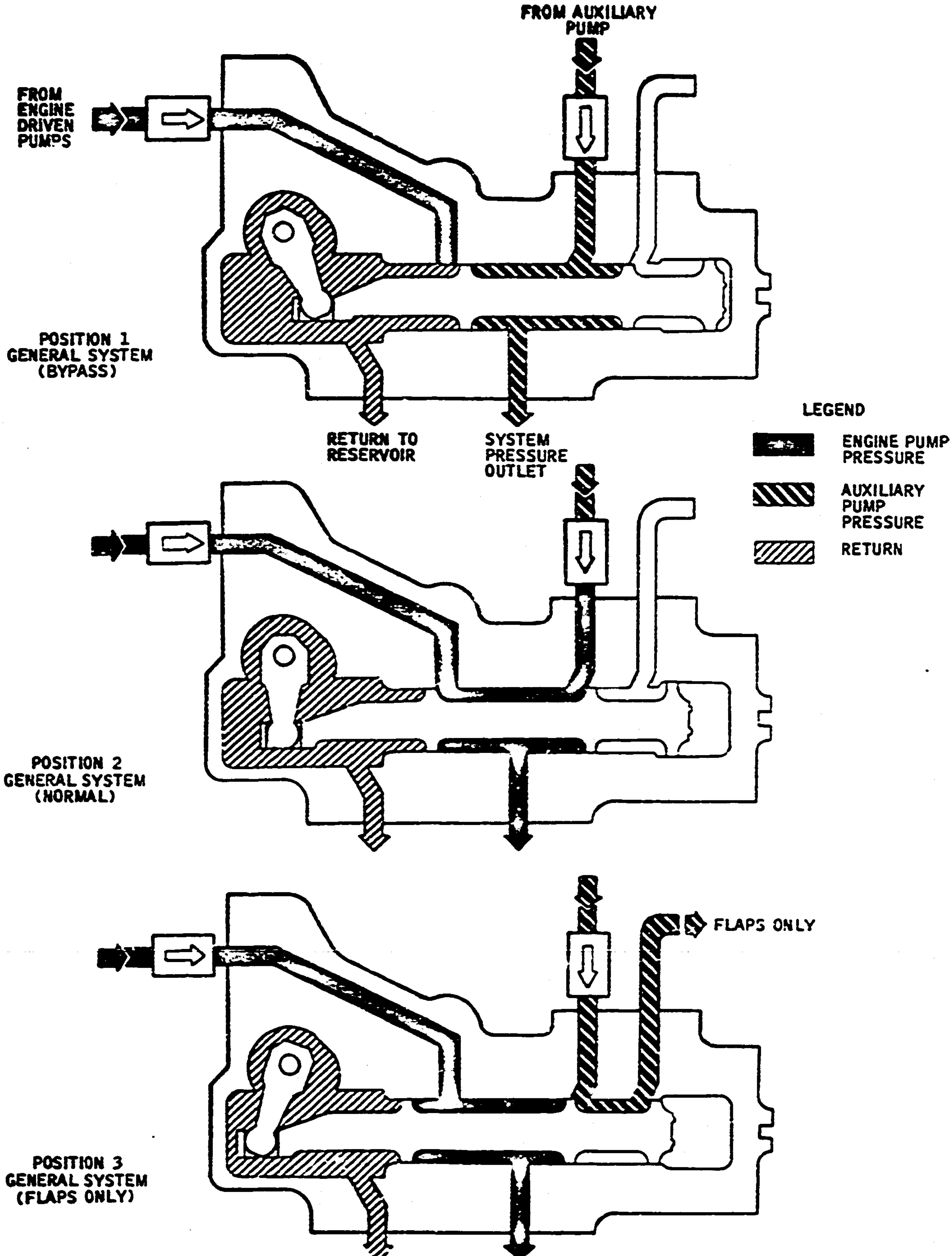
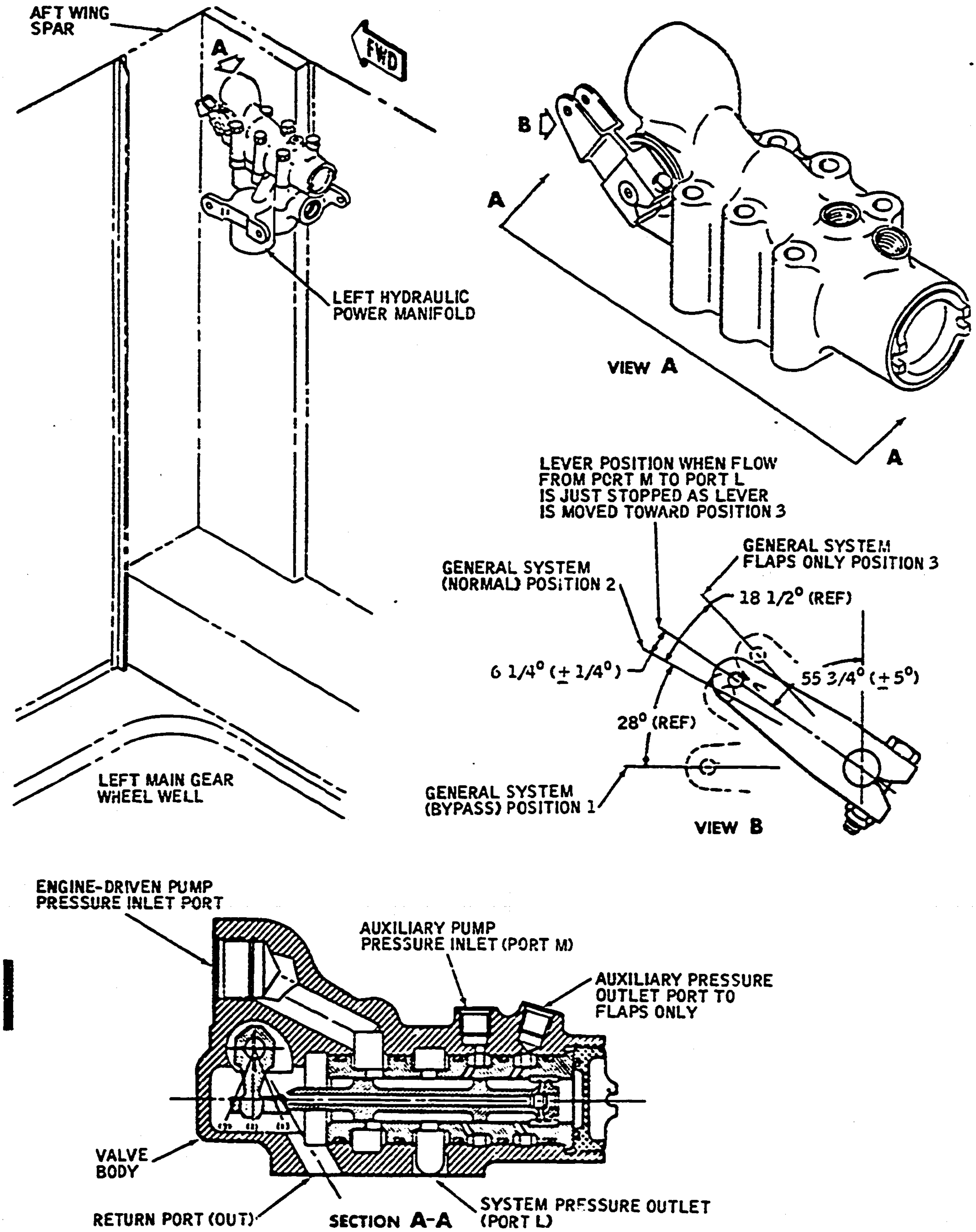
Dual-Filter and Relief Valve -- Cutaway Valve
Figure 15



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/flaps only position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps. Internal leakage provides lubrication for the moving parts of the valve.

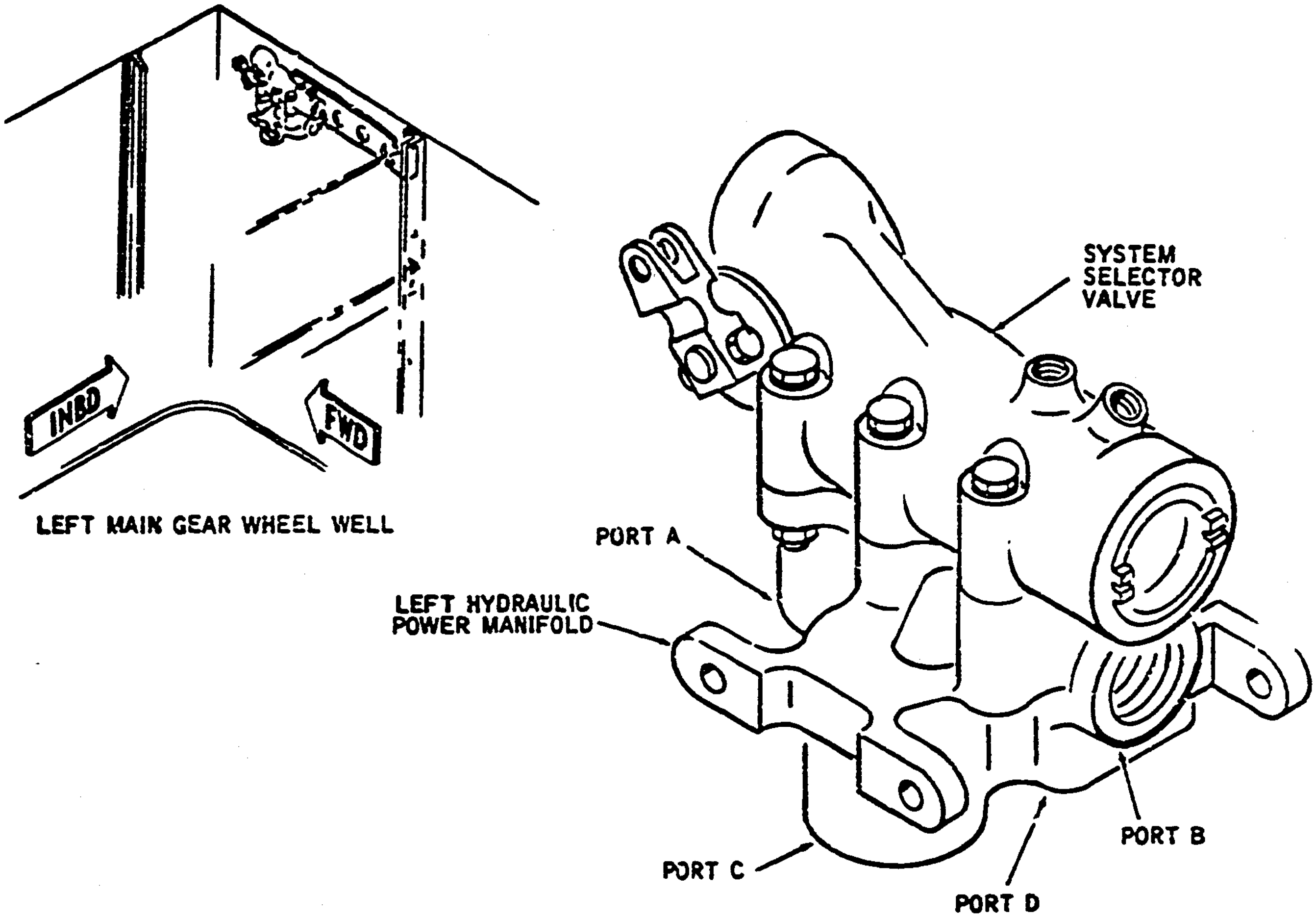
P. Left Hydraulic Power Manifold (See Figure 18.)

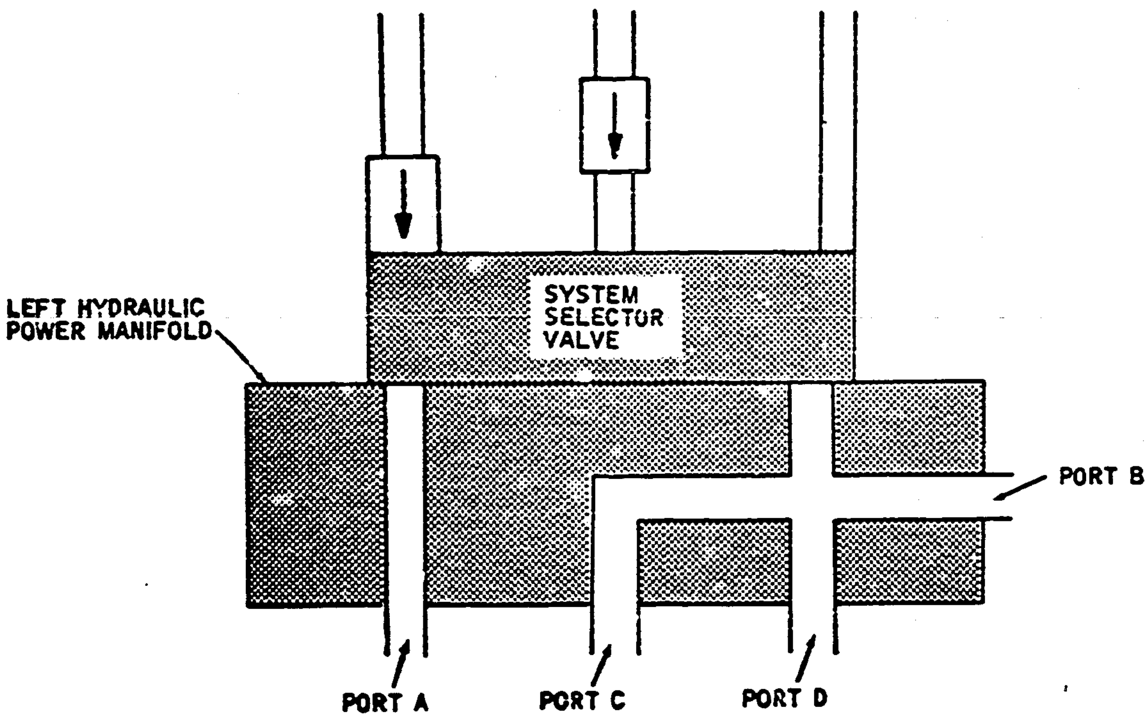
(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

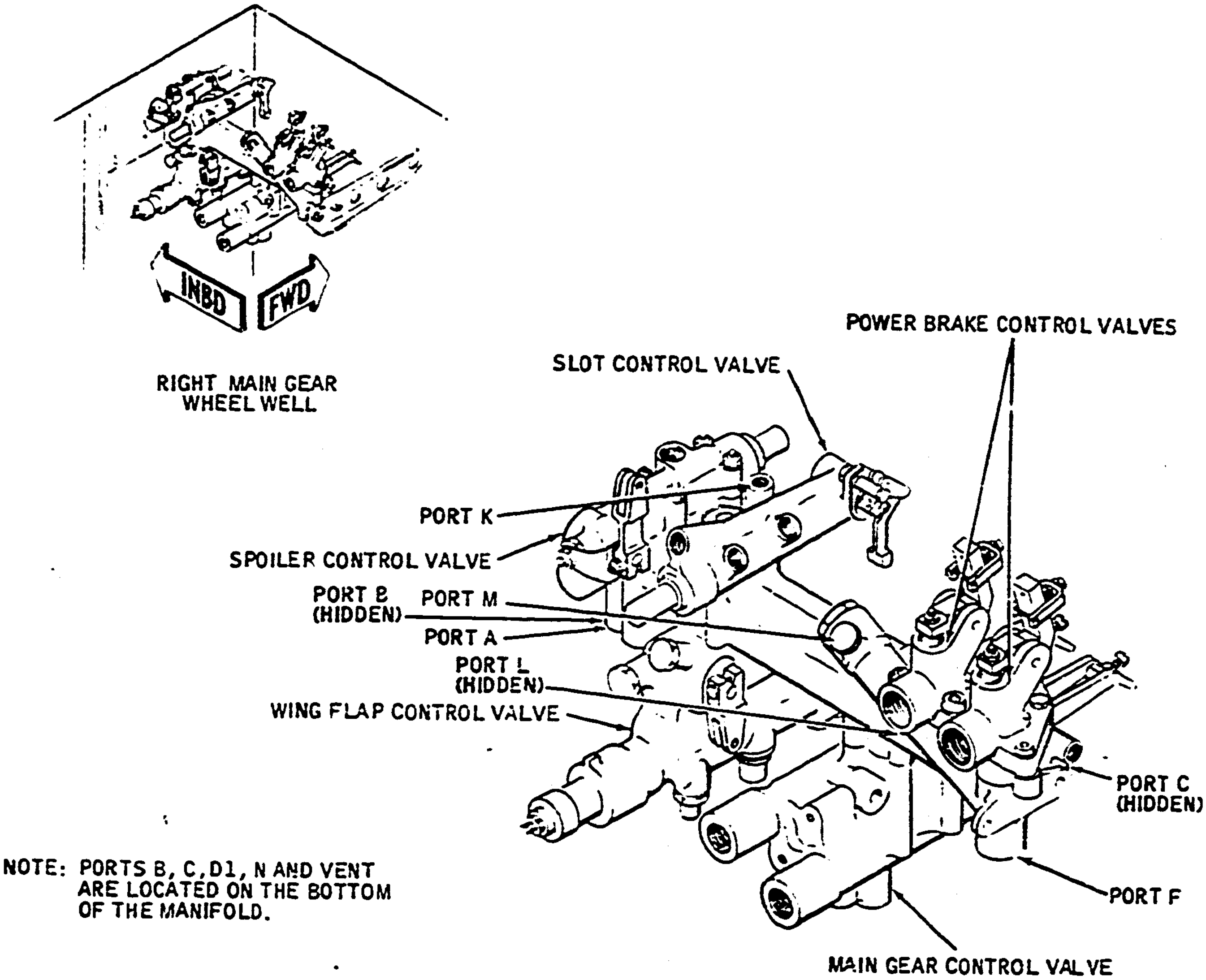
Q. Right Hydraulic Power Manifold (See Figure 19.)

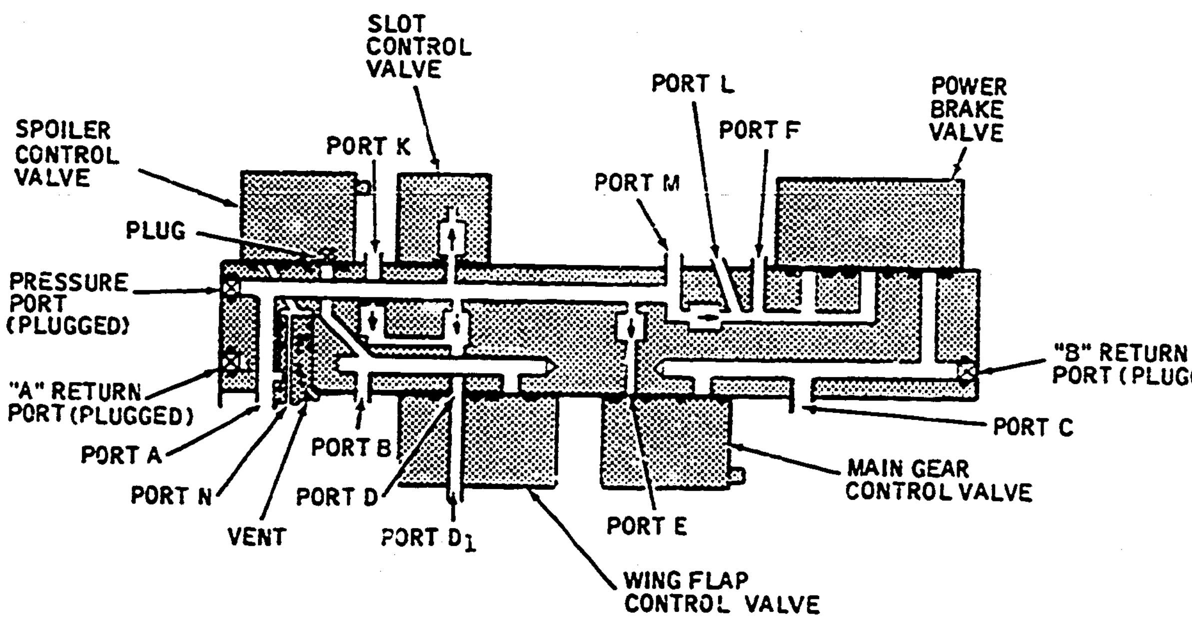
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in





Left Hydraulic Power Manifold -- Schematic
Figure 18





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Right Hydraulic Power Manifold -- Schematic
Figure 19

the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

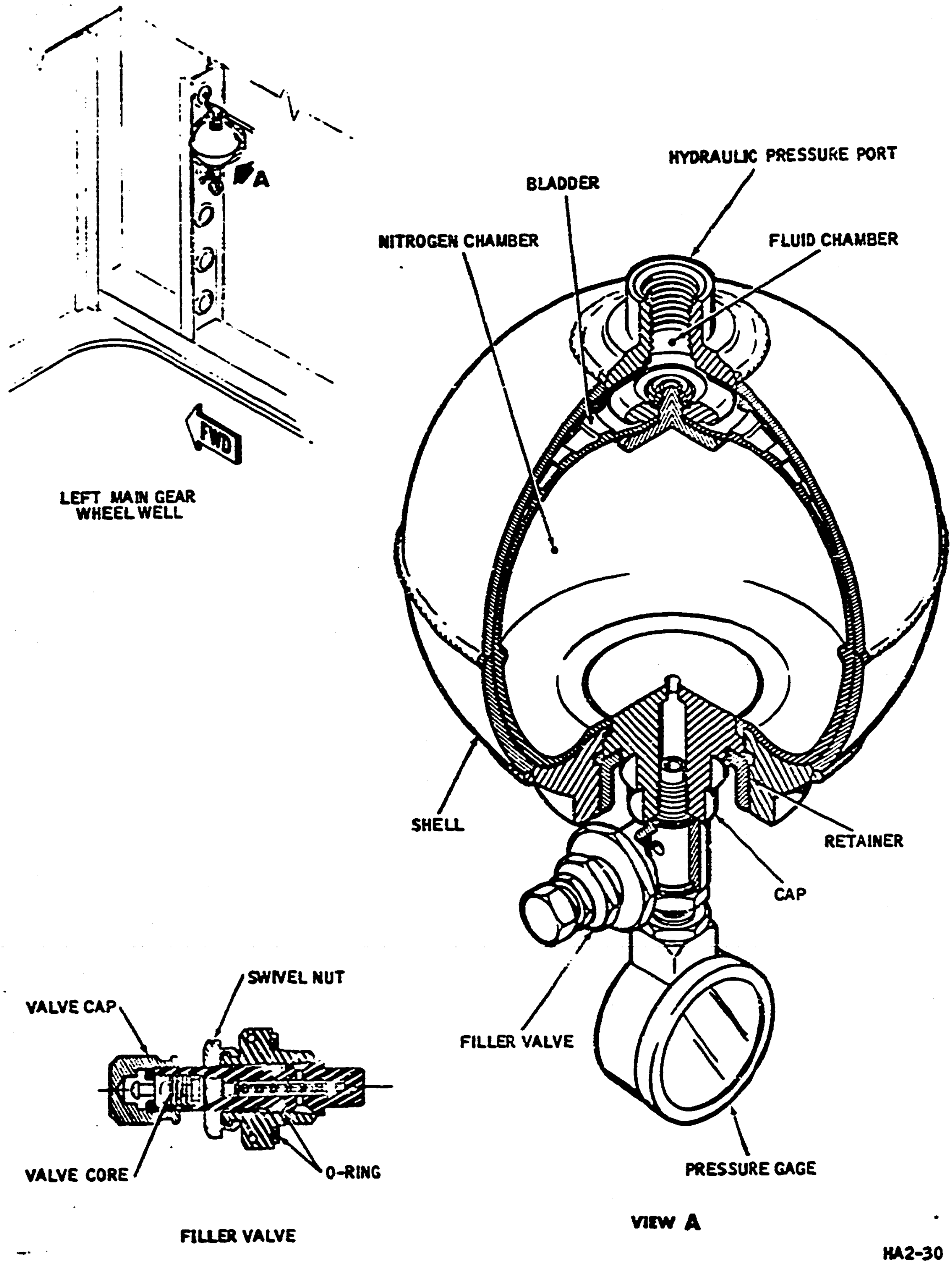
(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.



Hydraulic Power System Accumulator --
Cutaway View
Figure 20

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, therby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

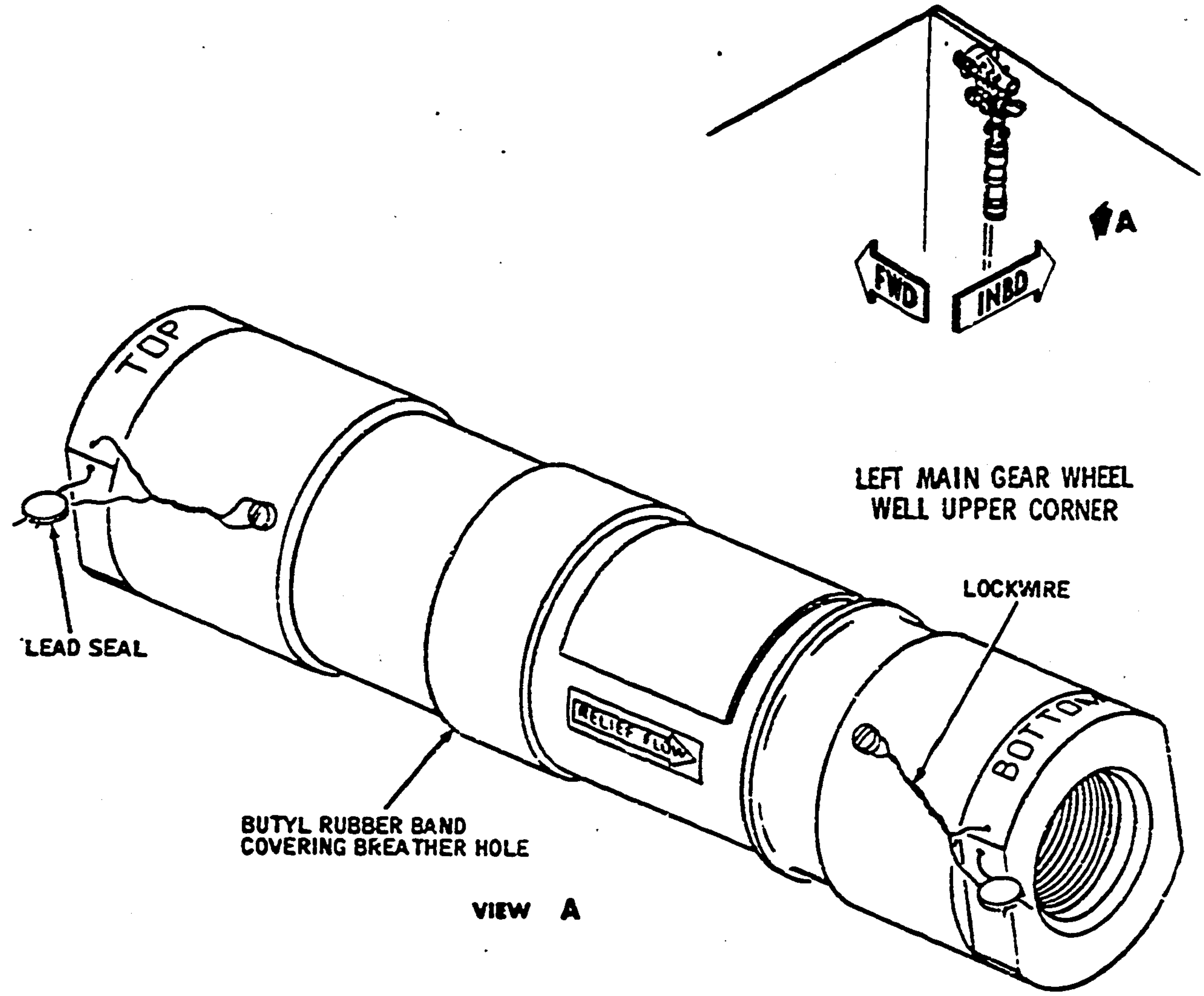
T. Hydraulic System Priority Valve (See Figure 21.)

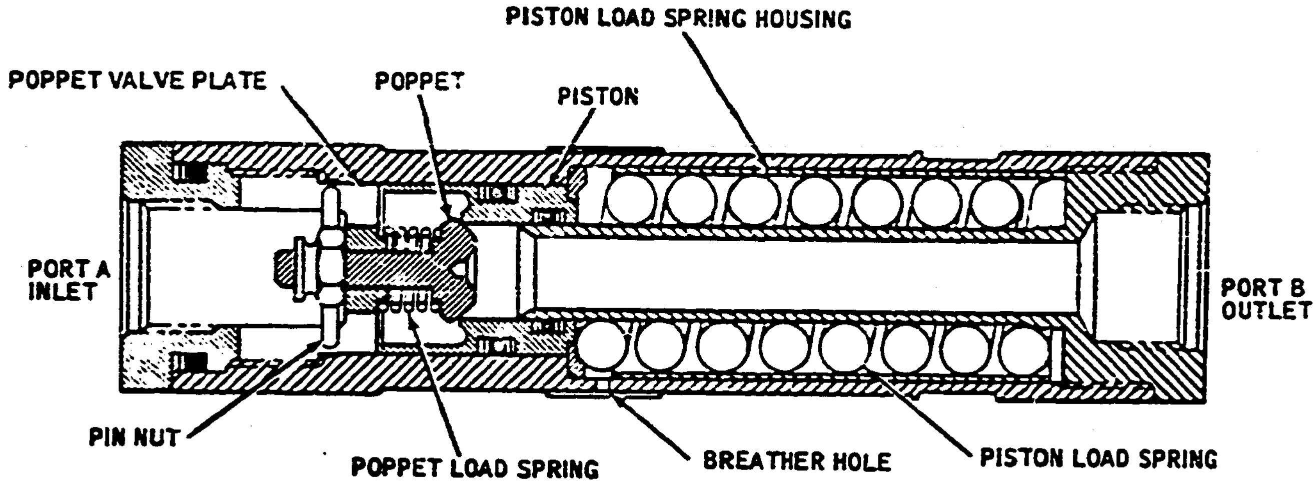
(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.





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Hydraulic System Priority Valve -- Cutaway View
Figure 21

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/flaps only position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the

auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

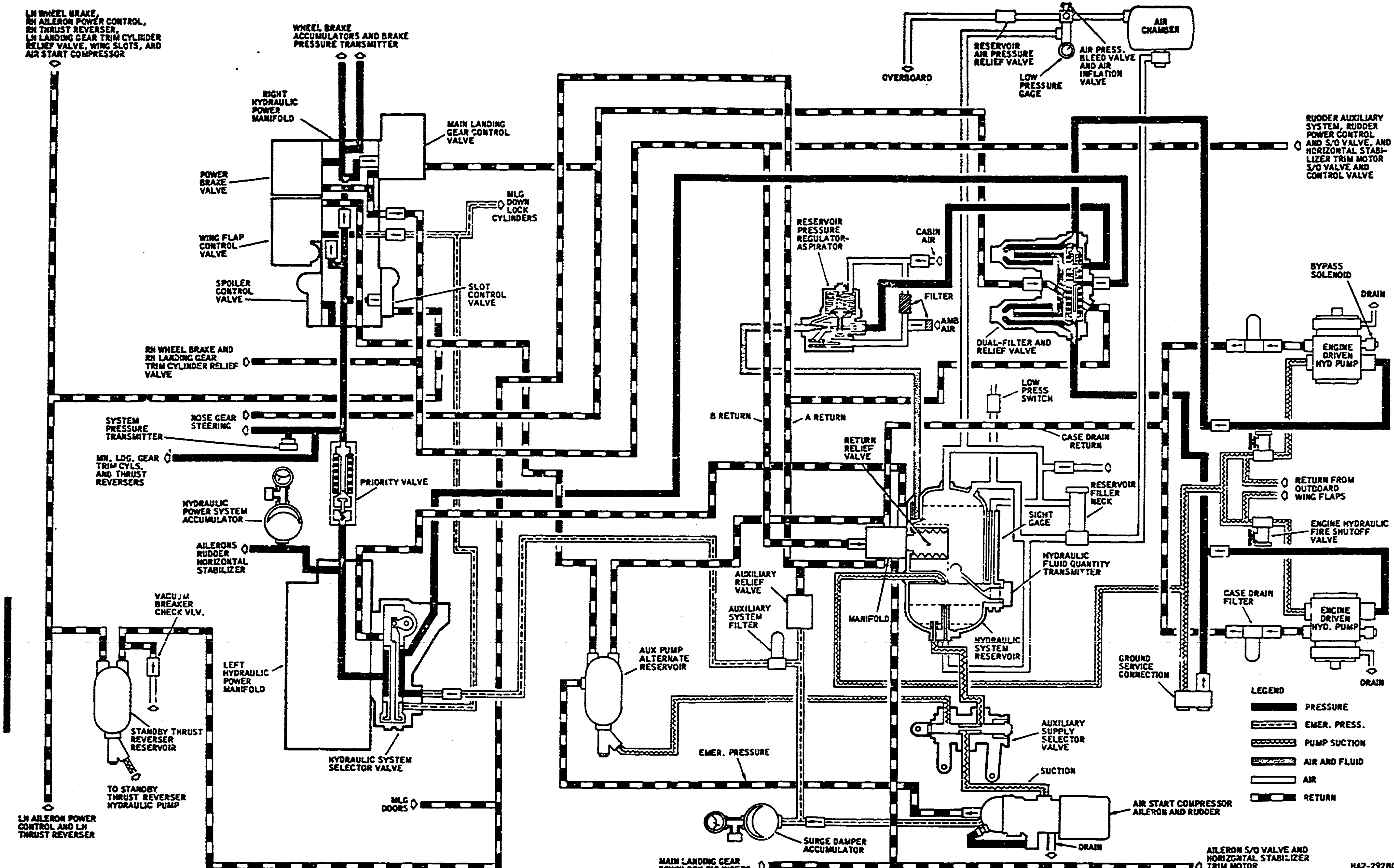
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

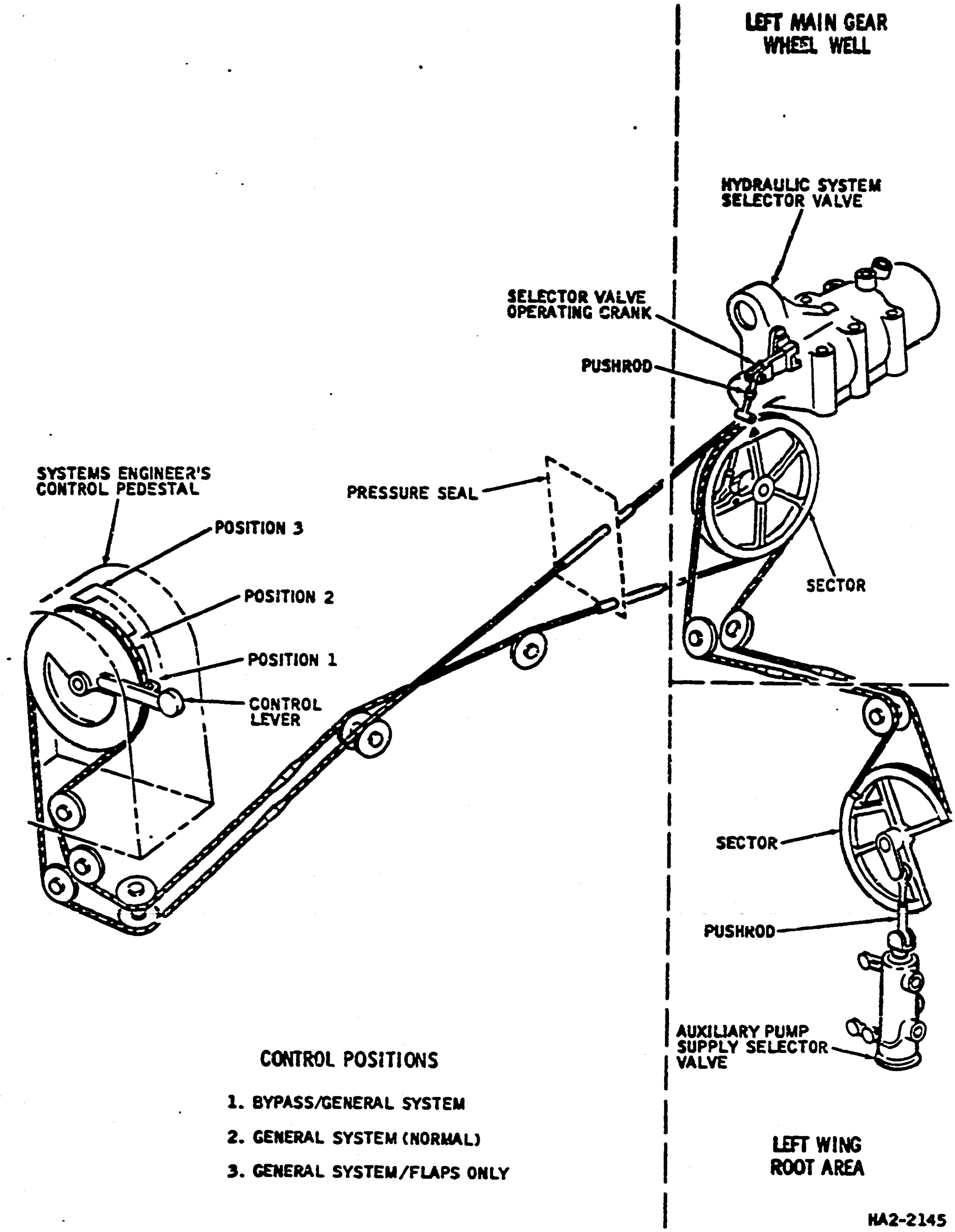
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram
Figure 1



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/flaps only position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/flaps only position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

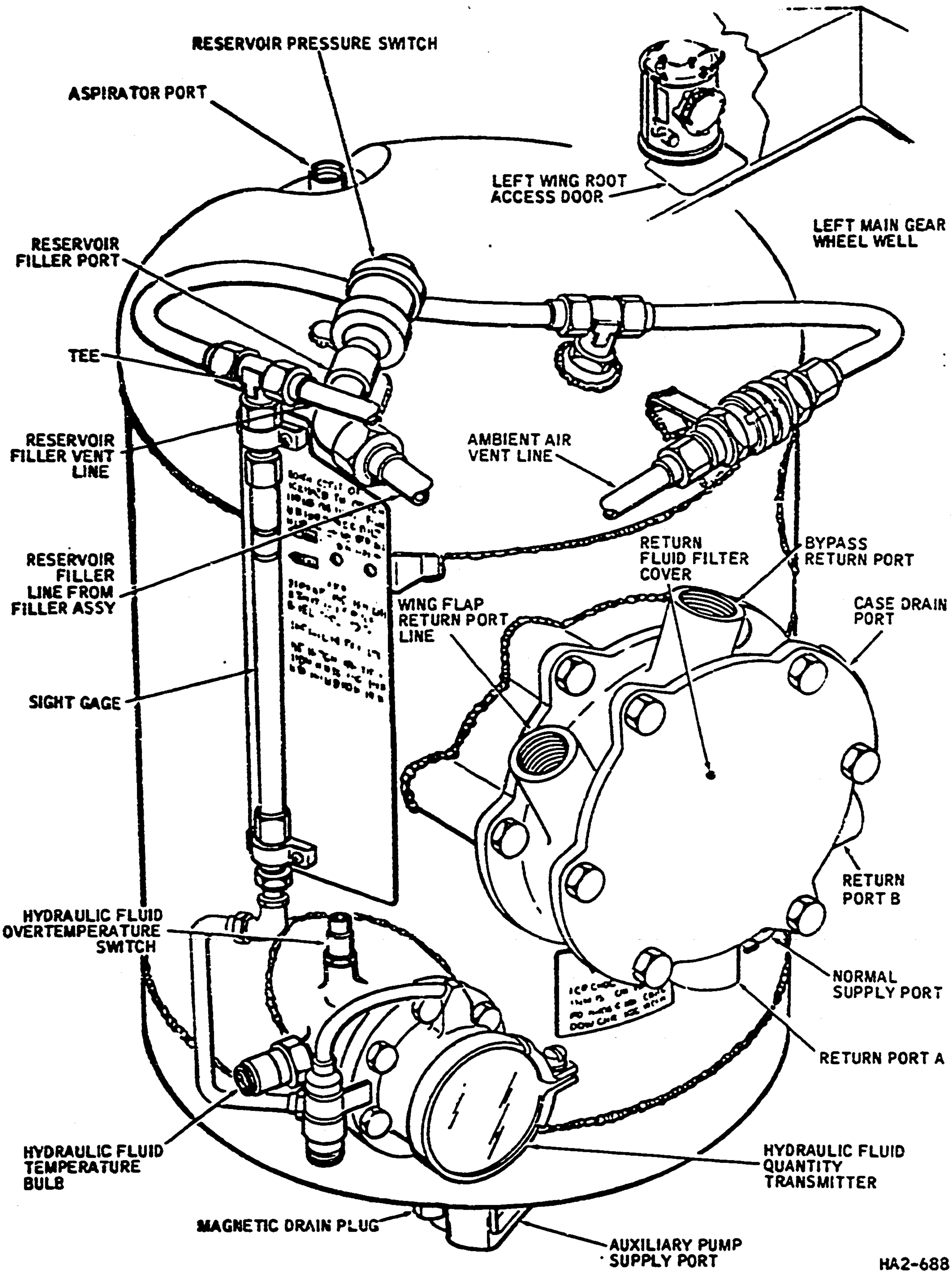
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/flaps only position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve. Engine-driven pump pressure is ported from the system selector valve to the general system.

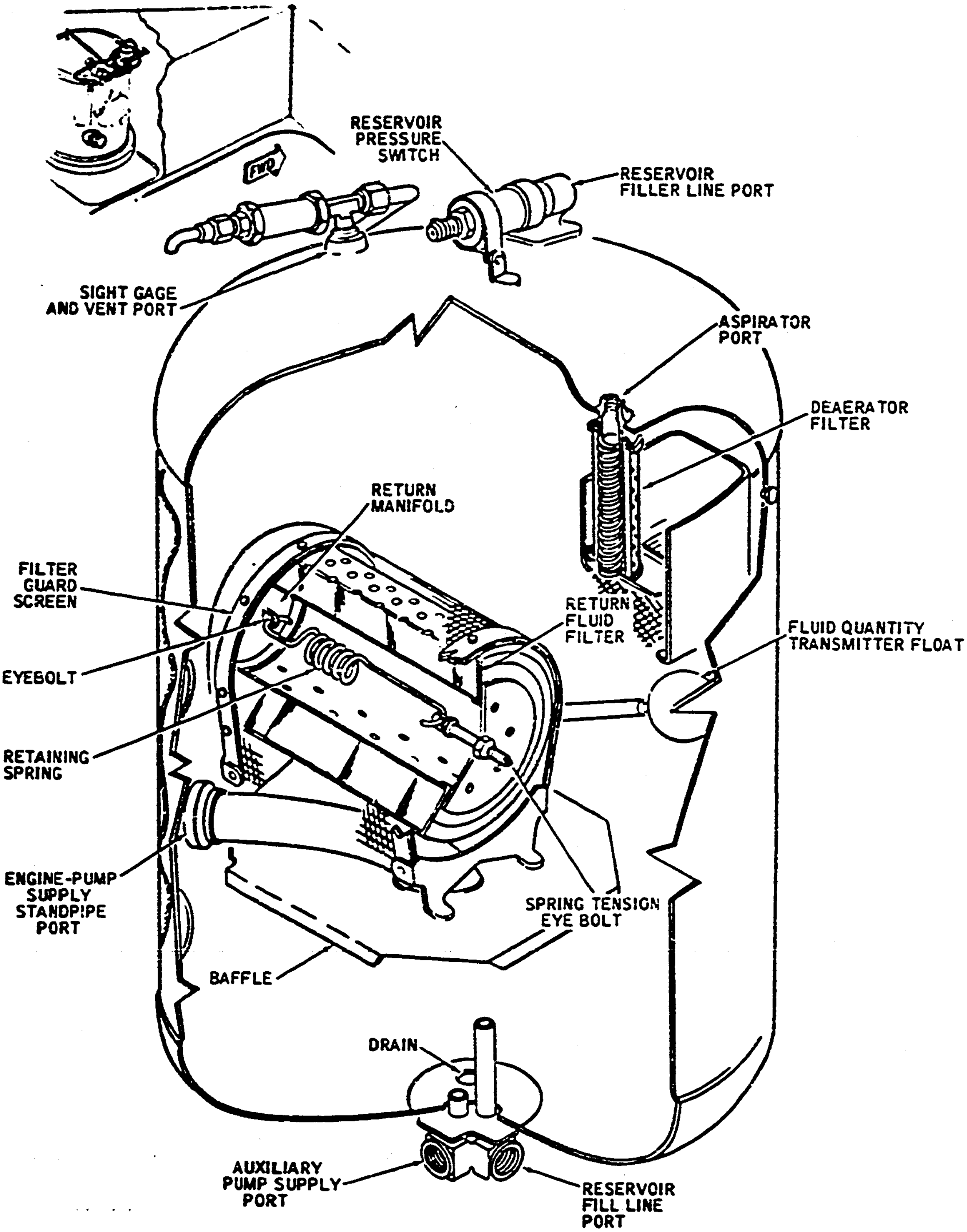
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by

removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

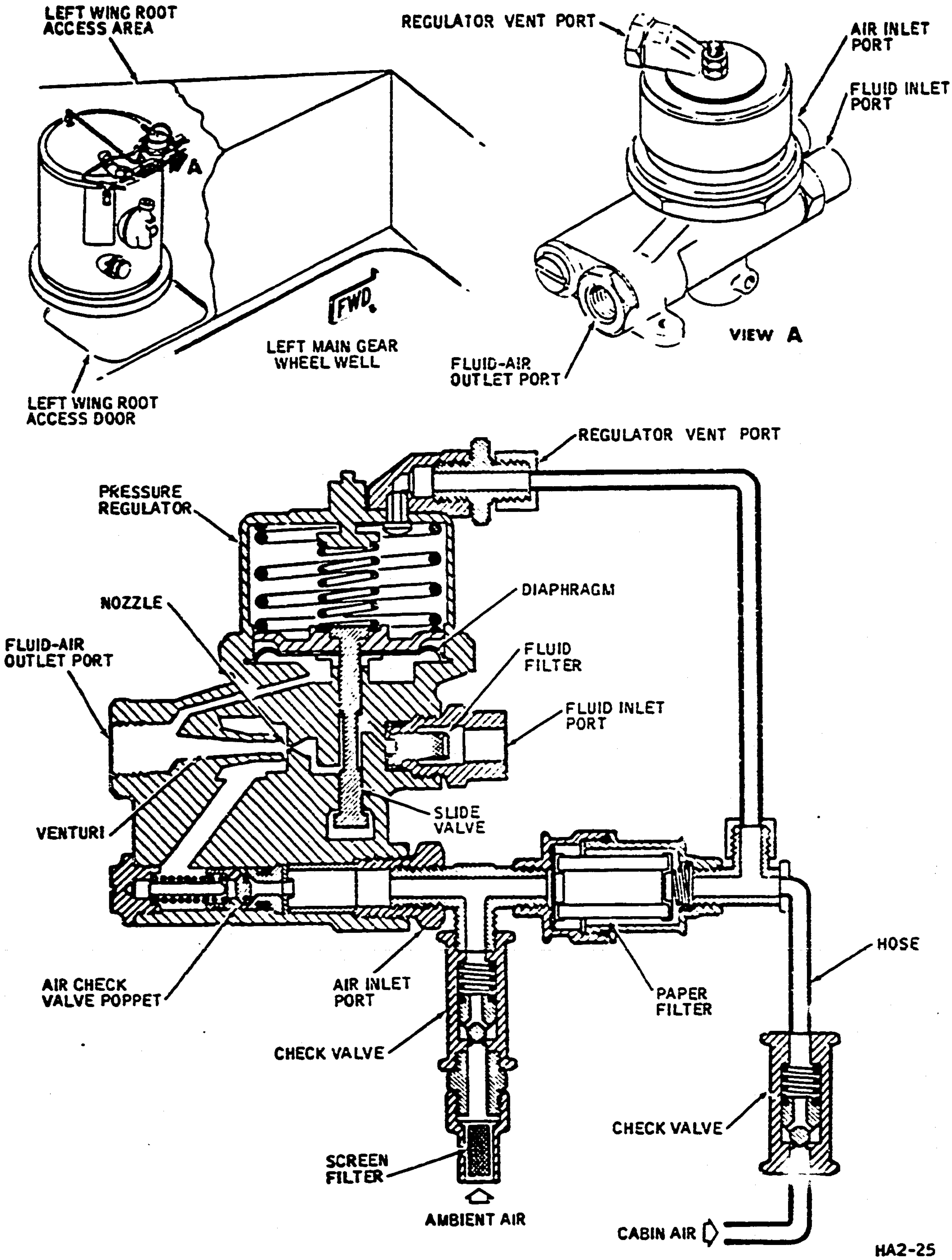
(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through



Reservoir Air Pressure Regulator-
Aspirator -- Schematic
Figure 5

the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

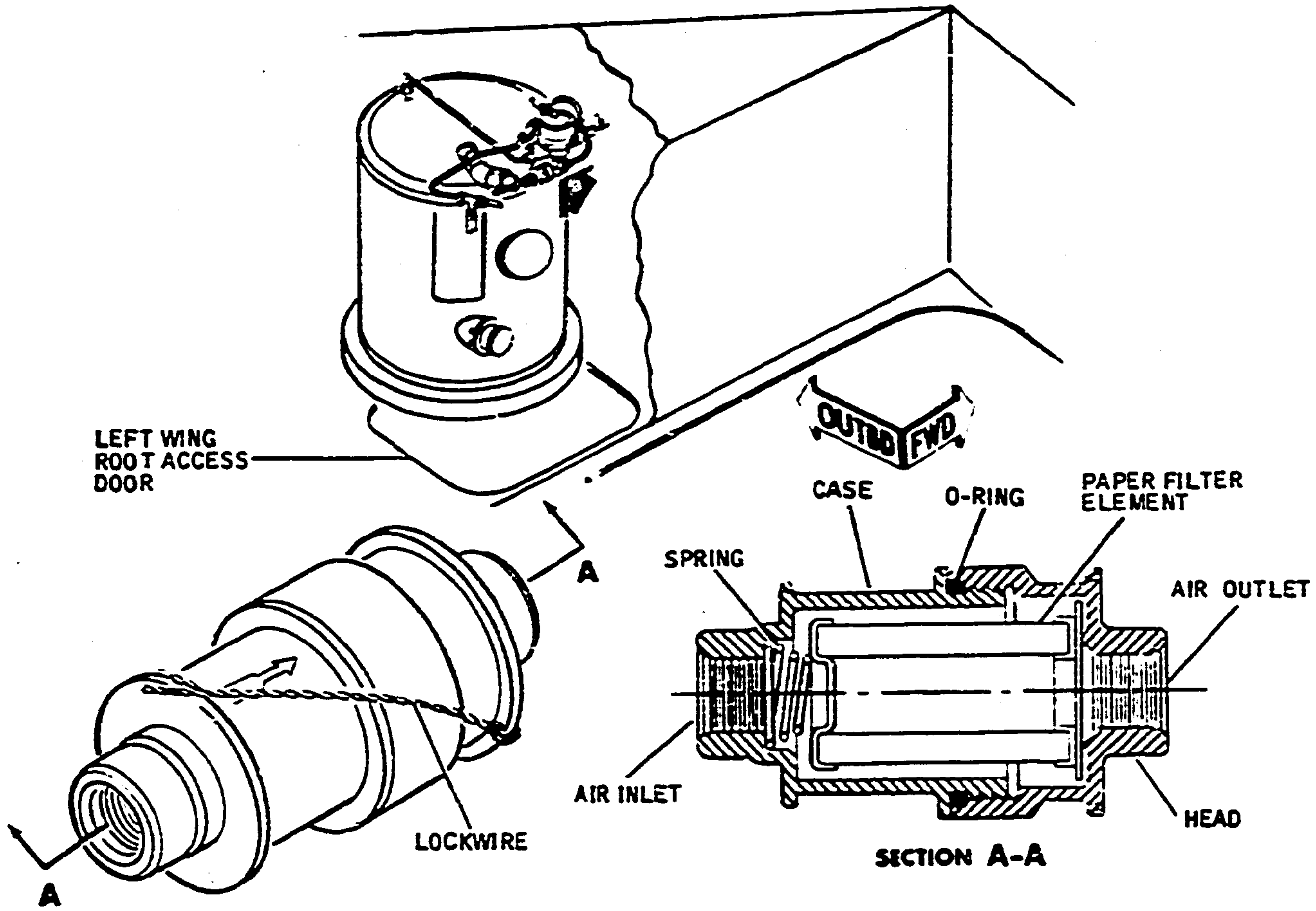
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

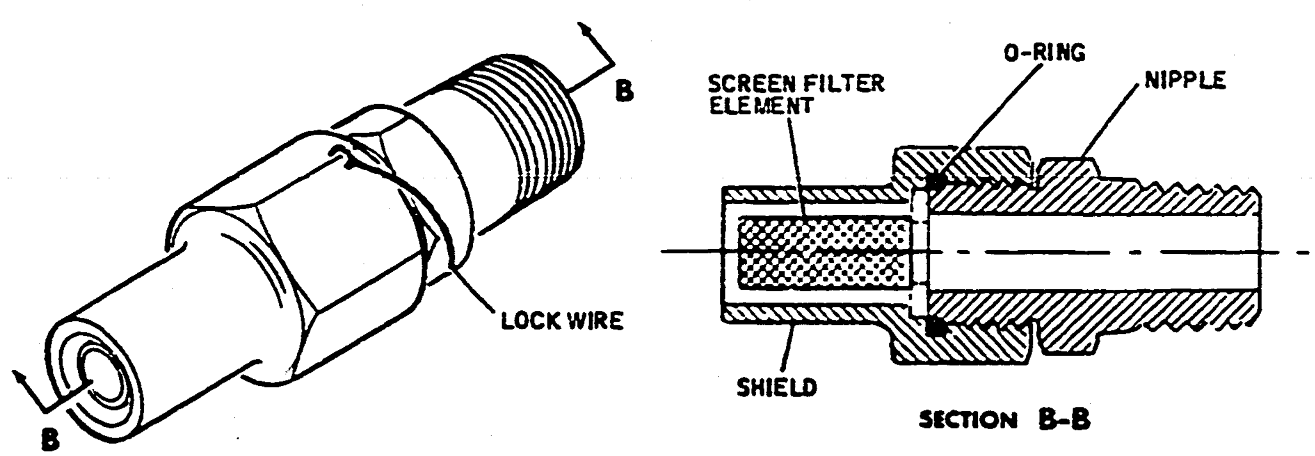
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port



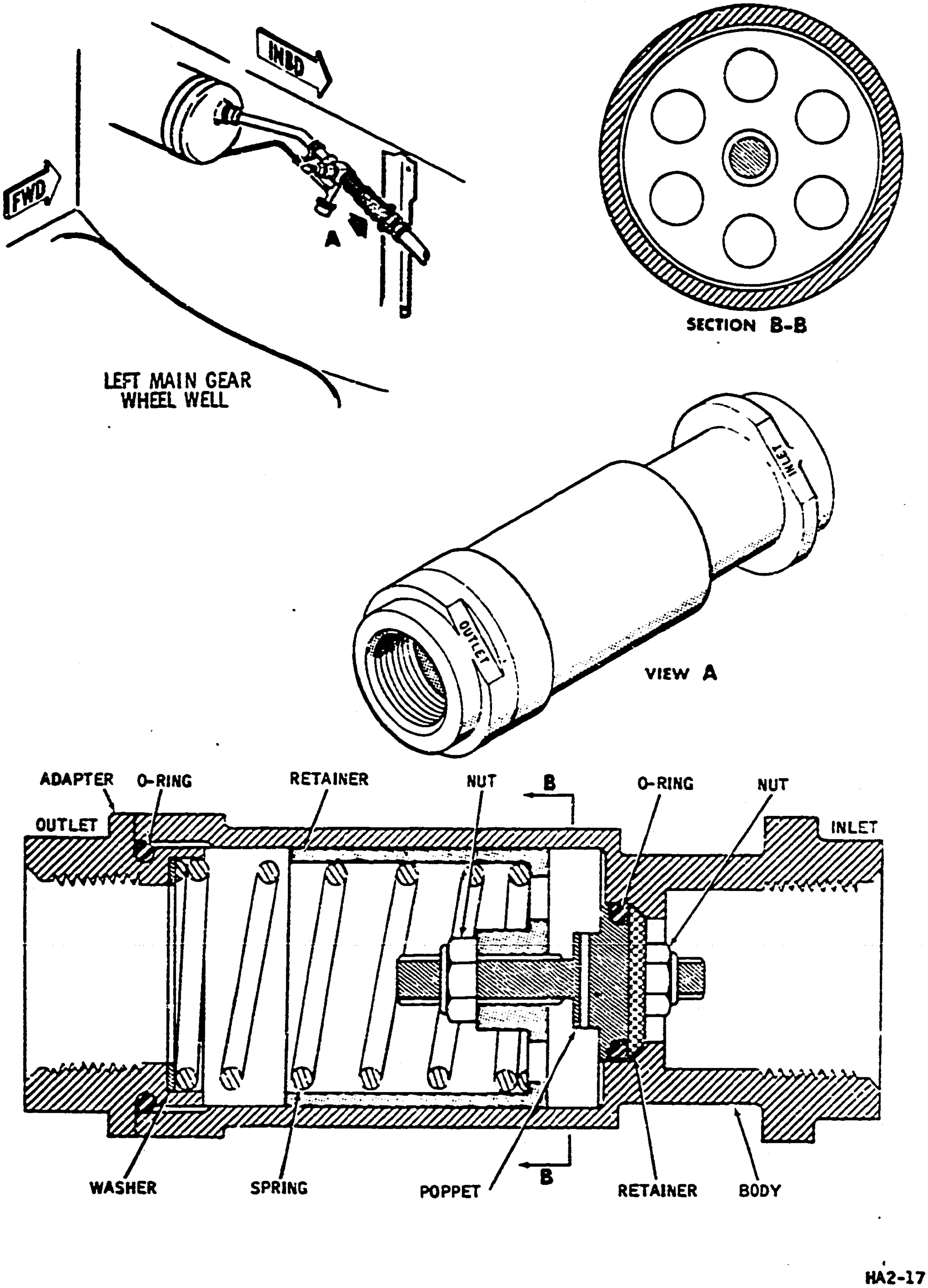
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator
Air Filters -- Cutaway View
Figure 6



Hydraulic Reservoir Relief Valve
Figure 7

and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

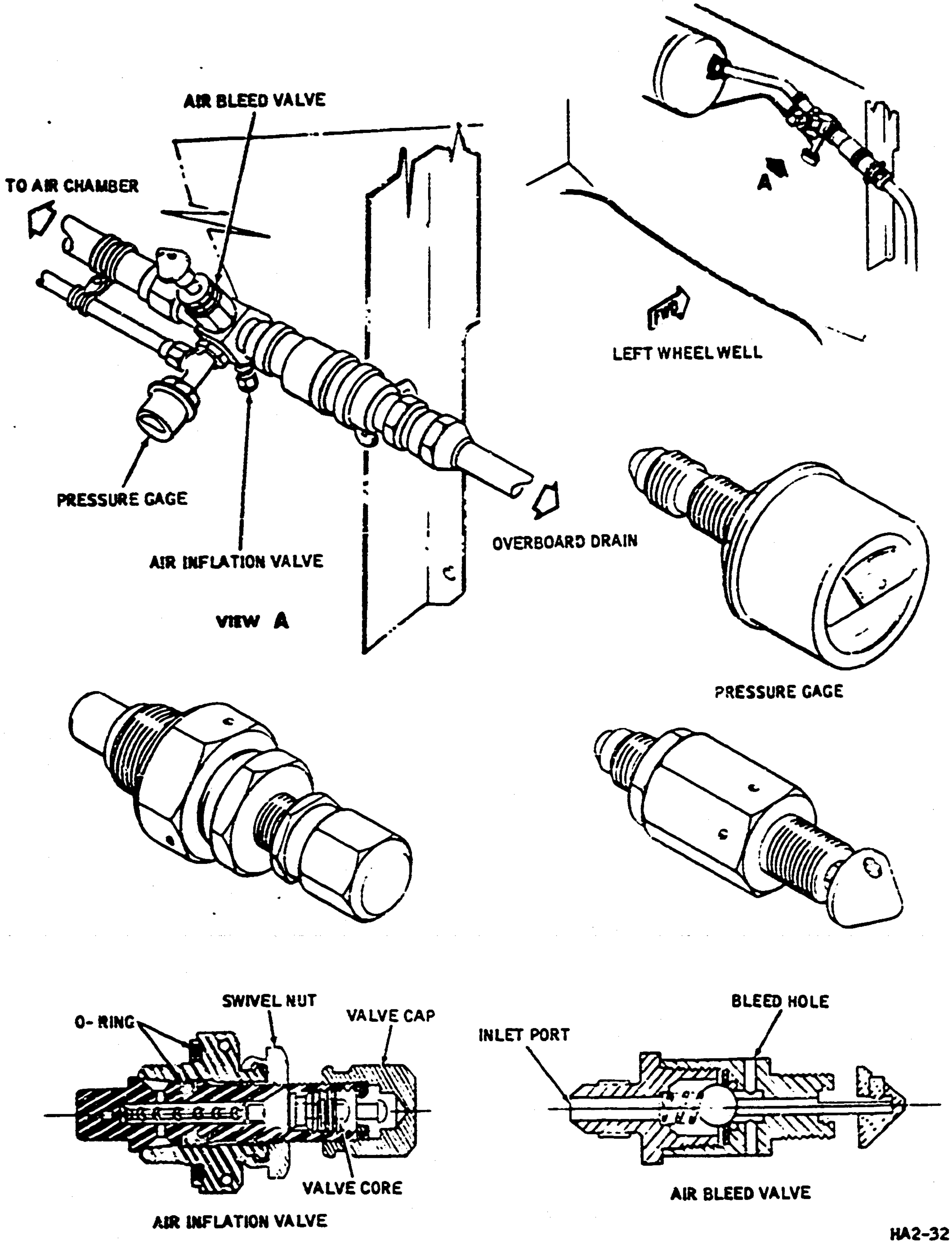
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

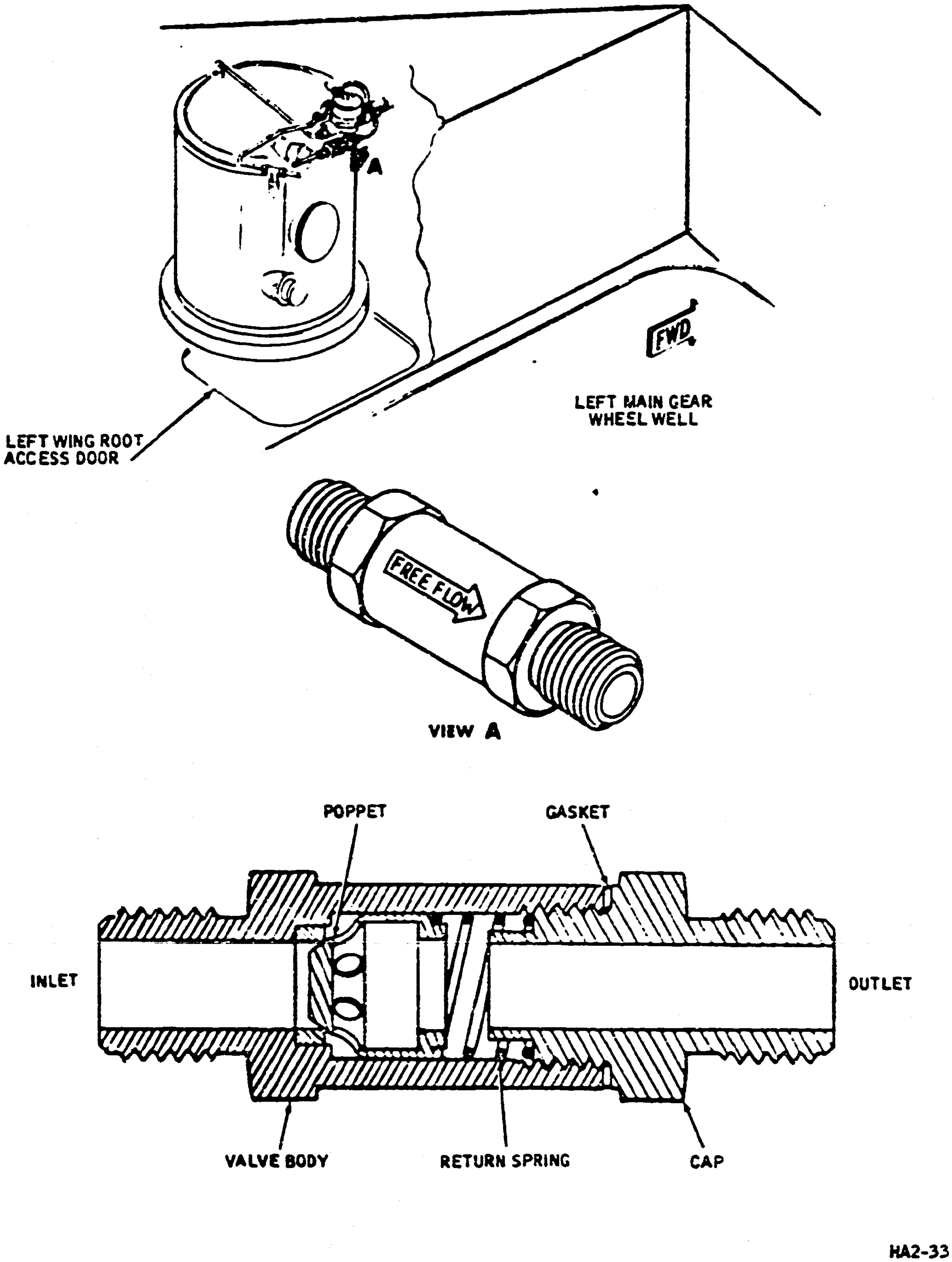
(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

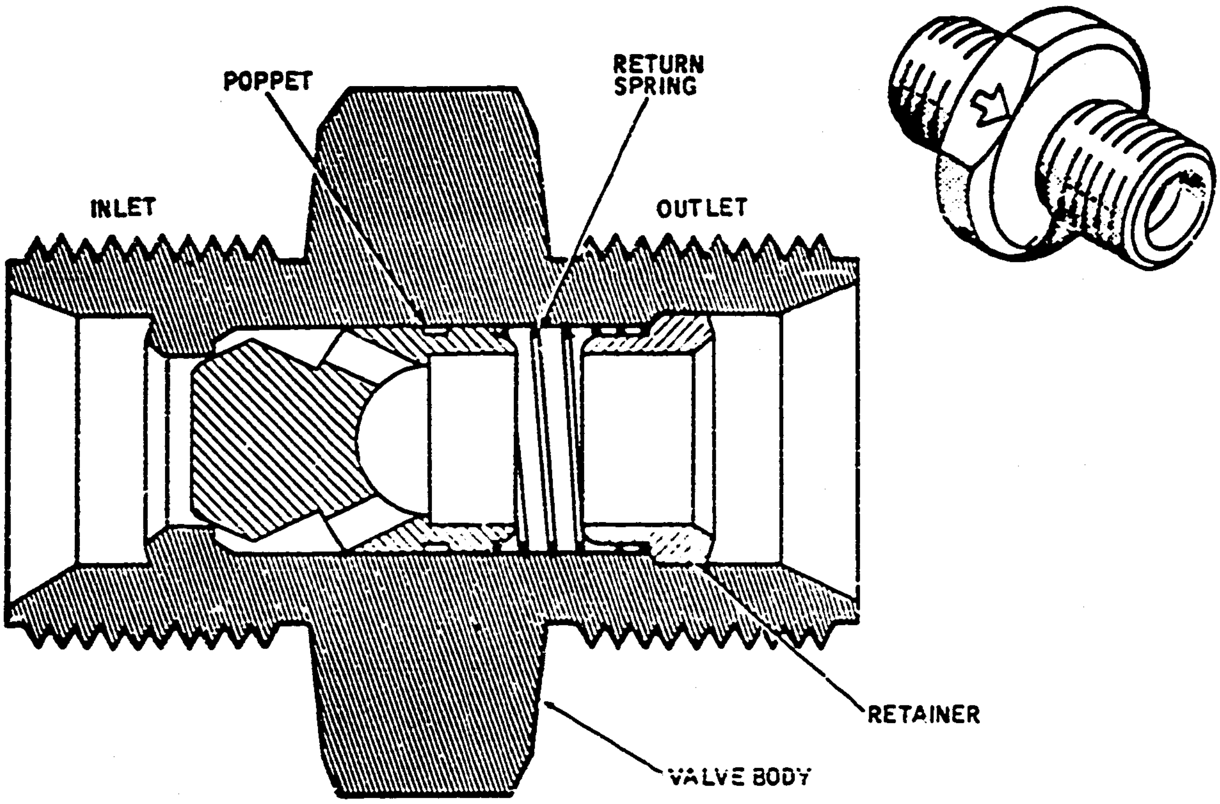
J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

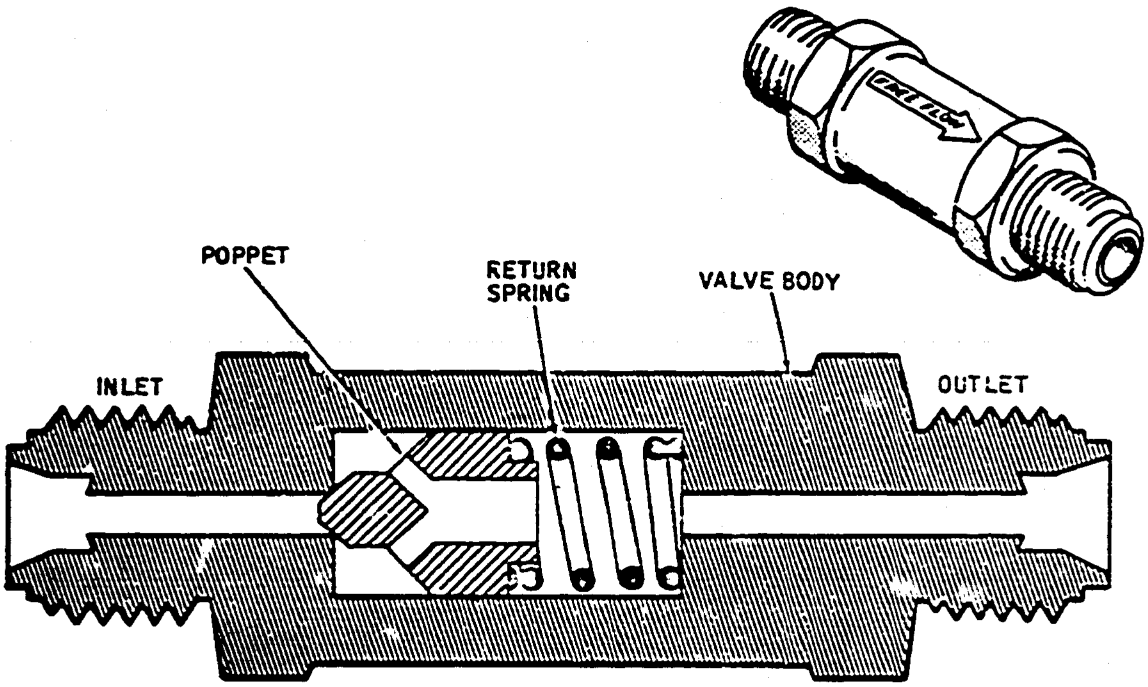
(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.



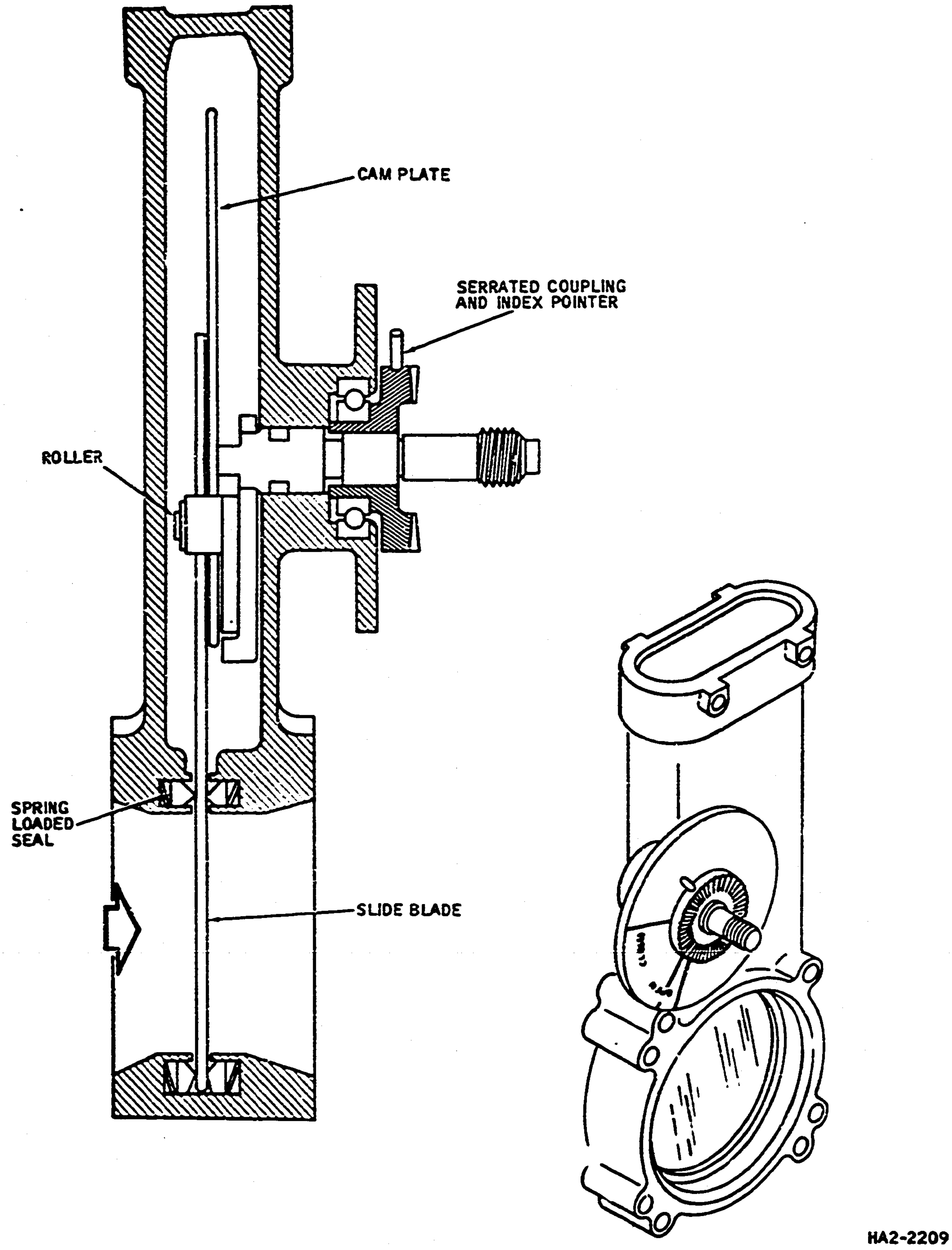
MINIATURE CHECK VALVE



STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff
Valve -- Schematic
Figure 11

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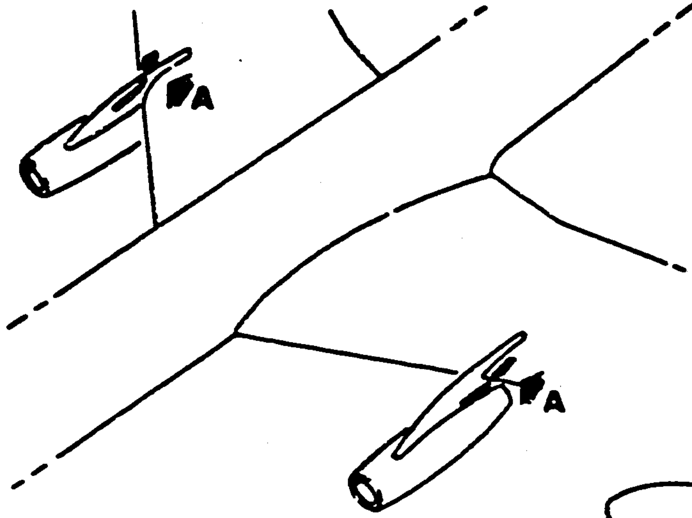
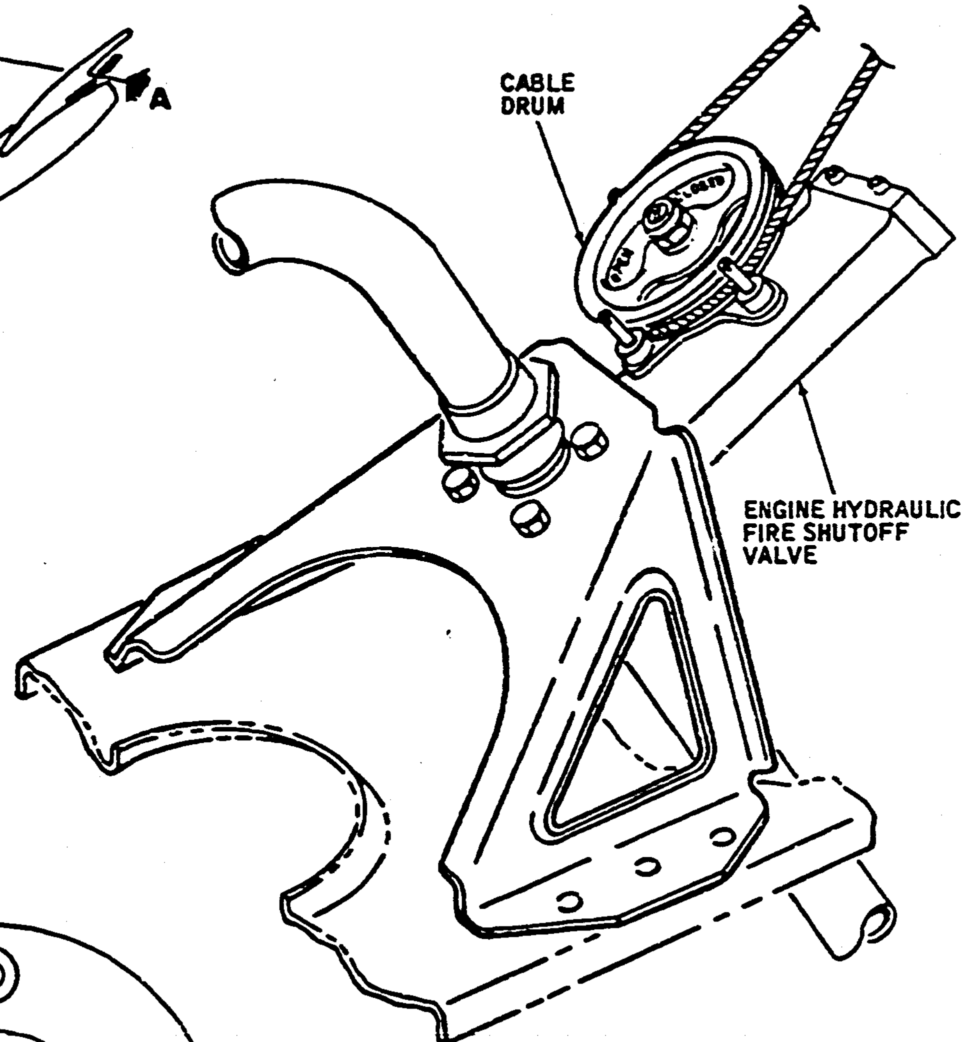
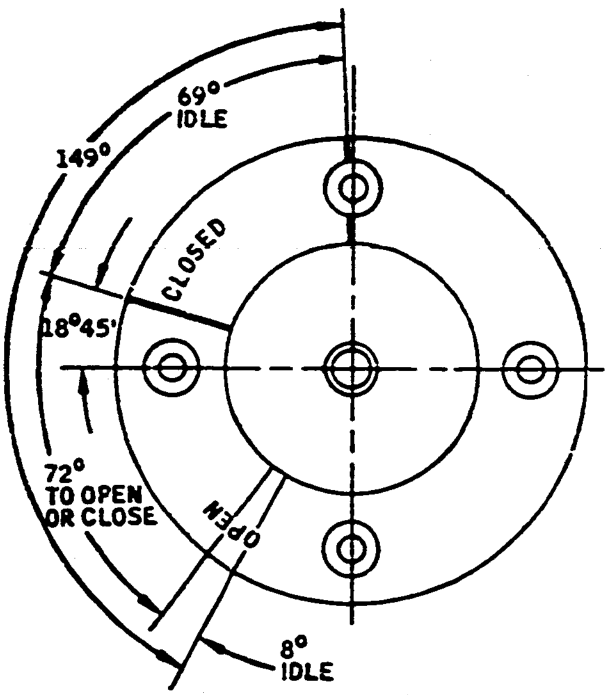




VIEW A



VALVE POSITION DIAGRAM

HA2-2978

Engine Hydraulic Fire Shutoff Valve
Figure 12

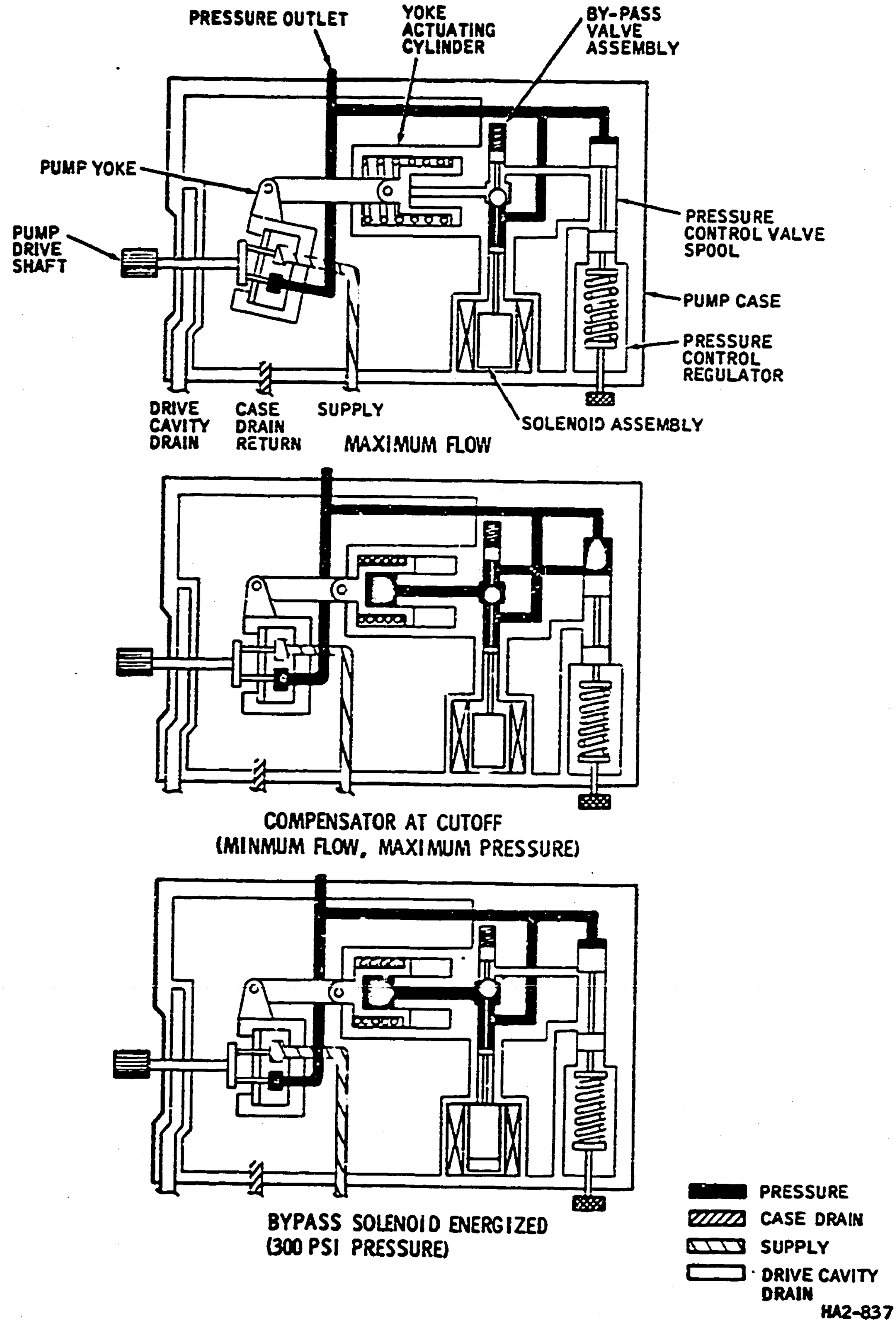
(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided; two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.



Engine-Driven Hydraulic Pump Pressure-Flow -- Schematic
Figure 13

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating driven shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

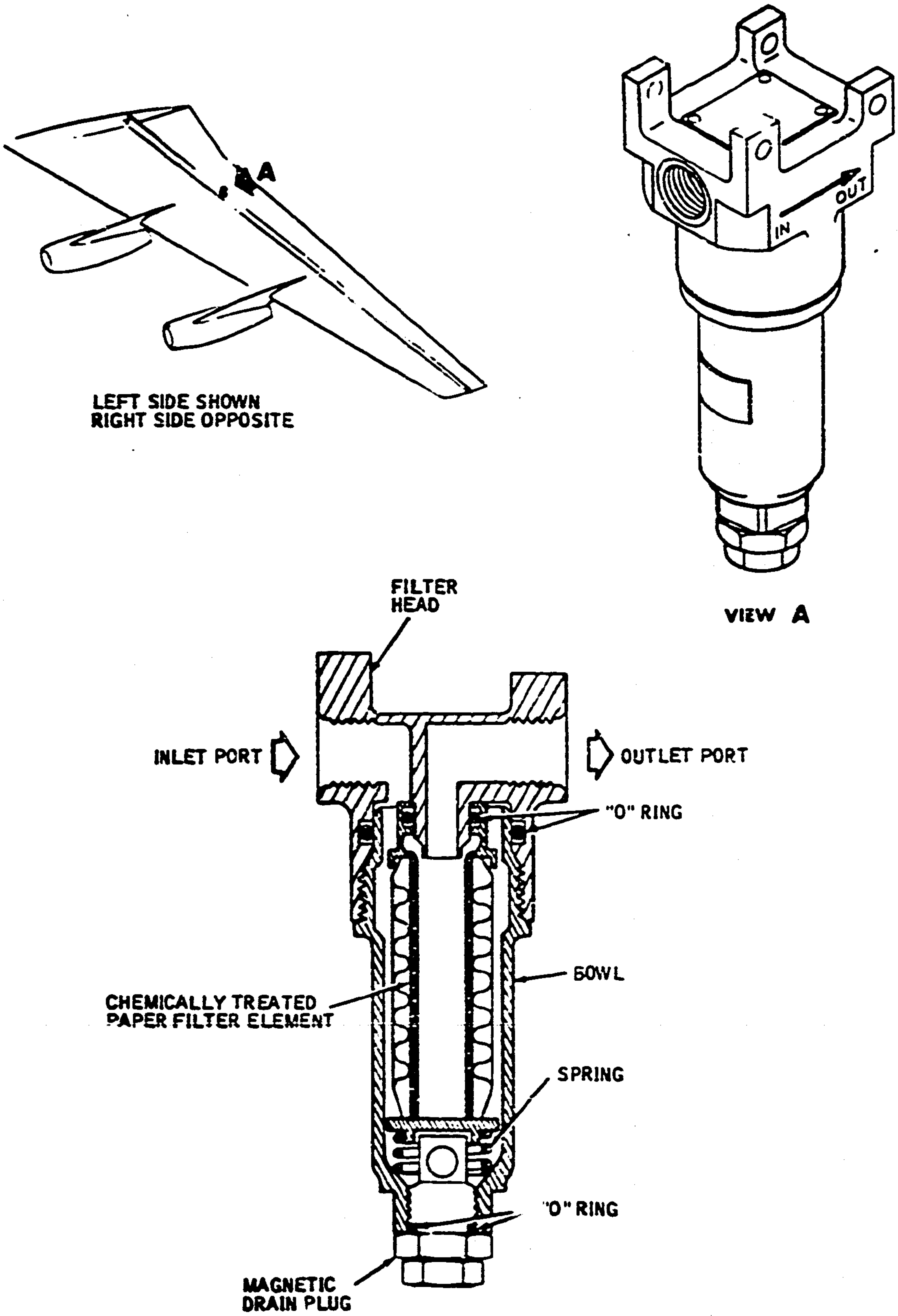
L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain



HA2-31

Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

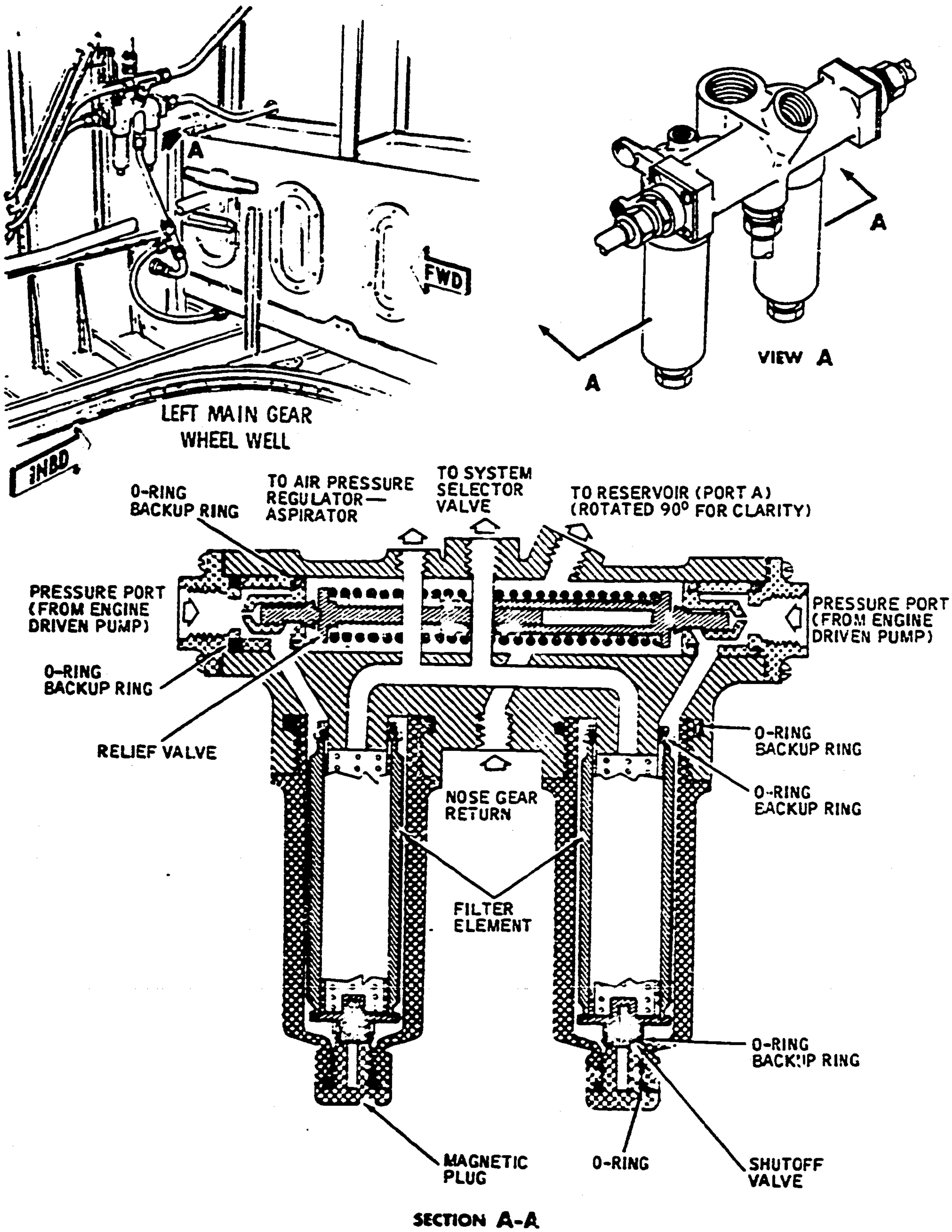
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



HA2-20

Dual-Filter and Relief Valve -- Cutaway Valve
Figure 15

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

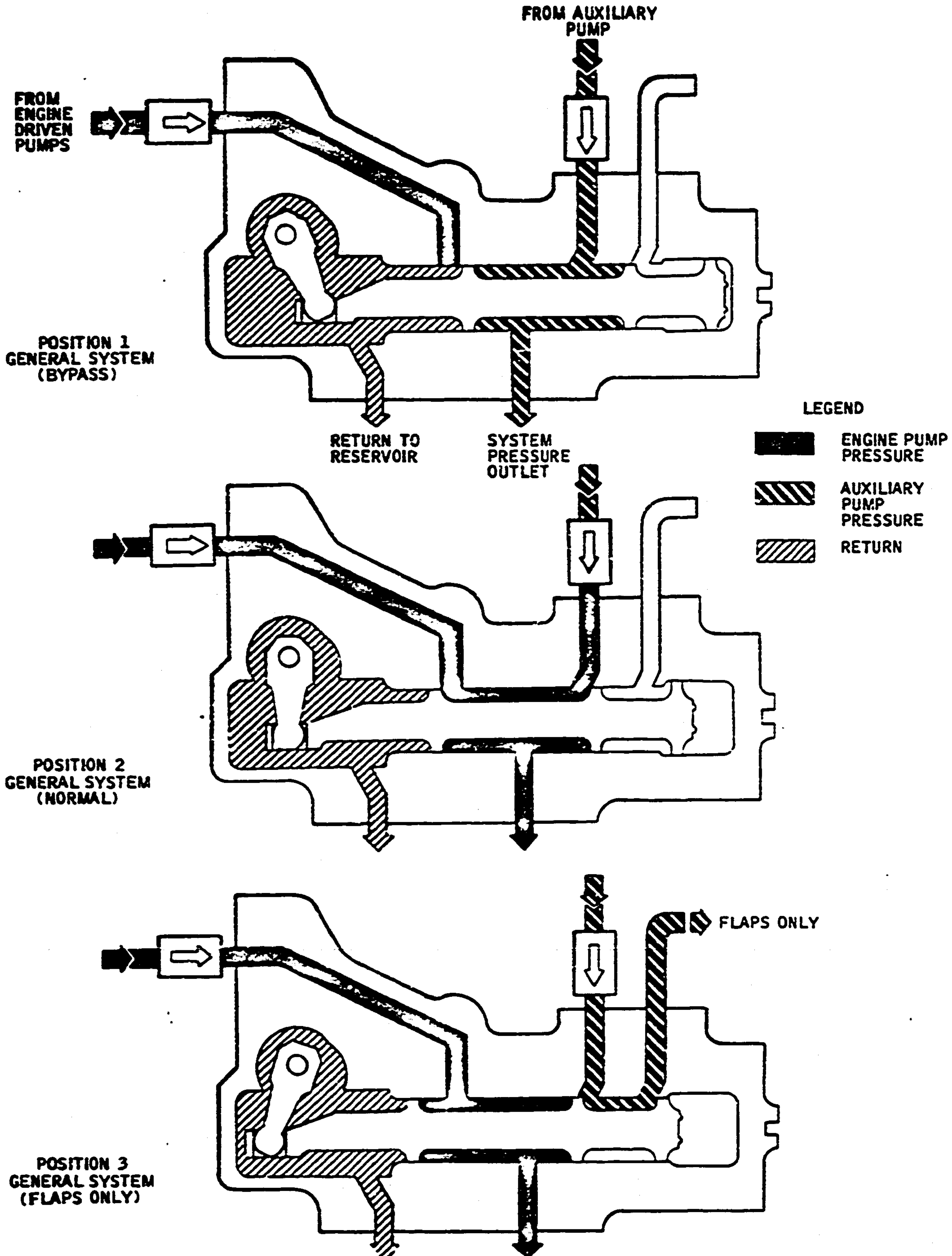
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/flaps only position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps. Internal leakage provides lubrication for the moving parts of the valve.

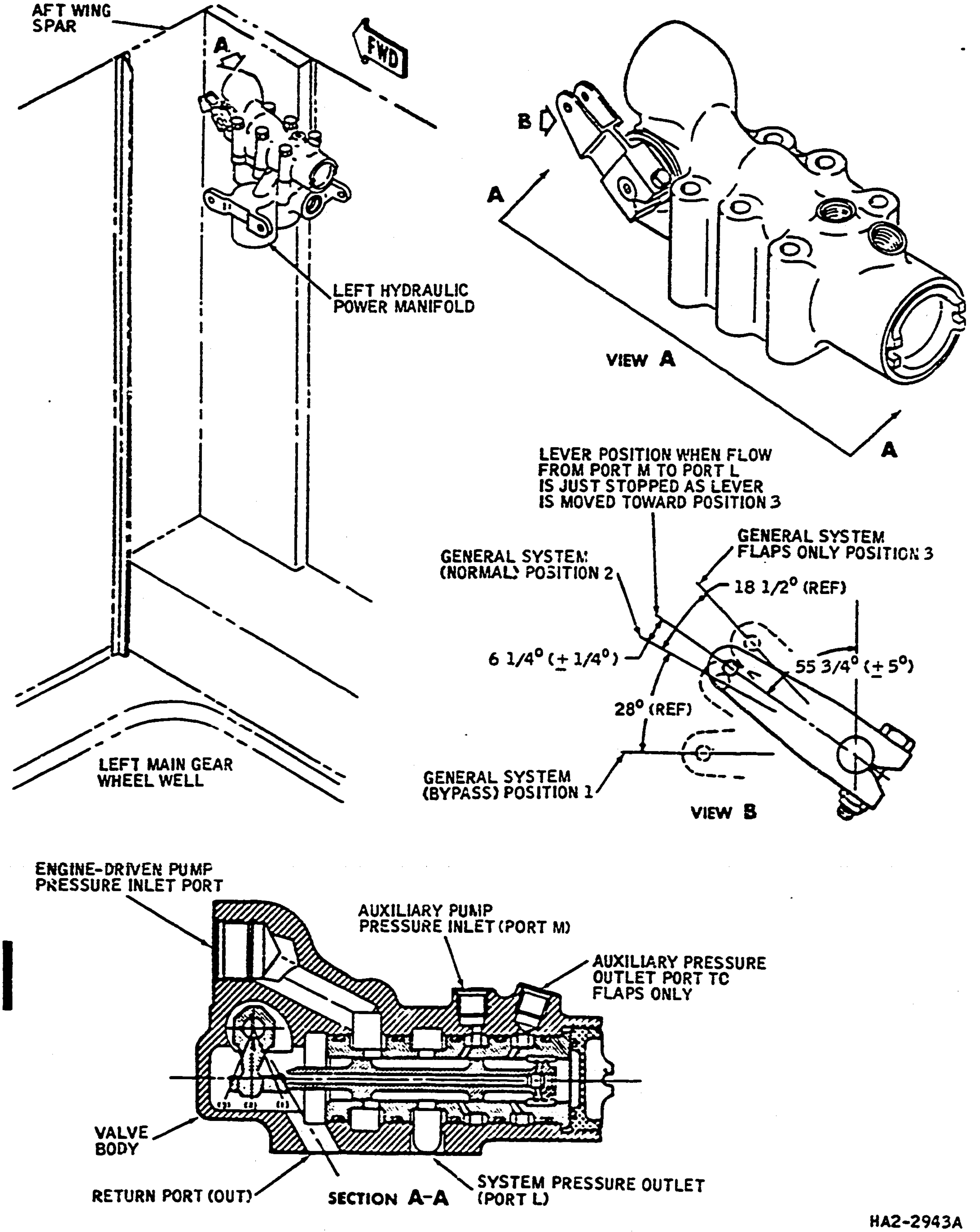
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

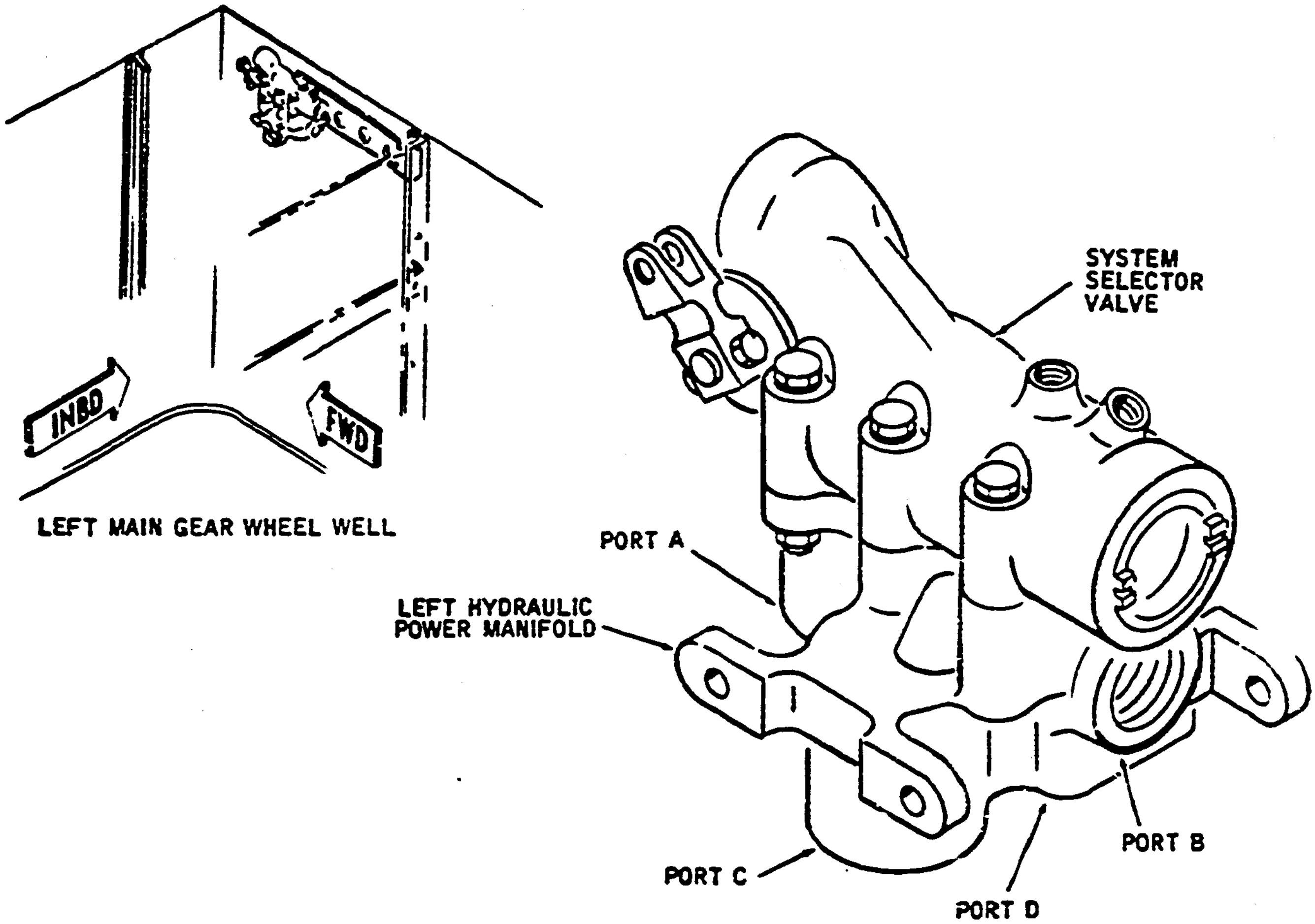
(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

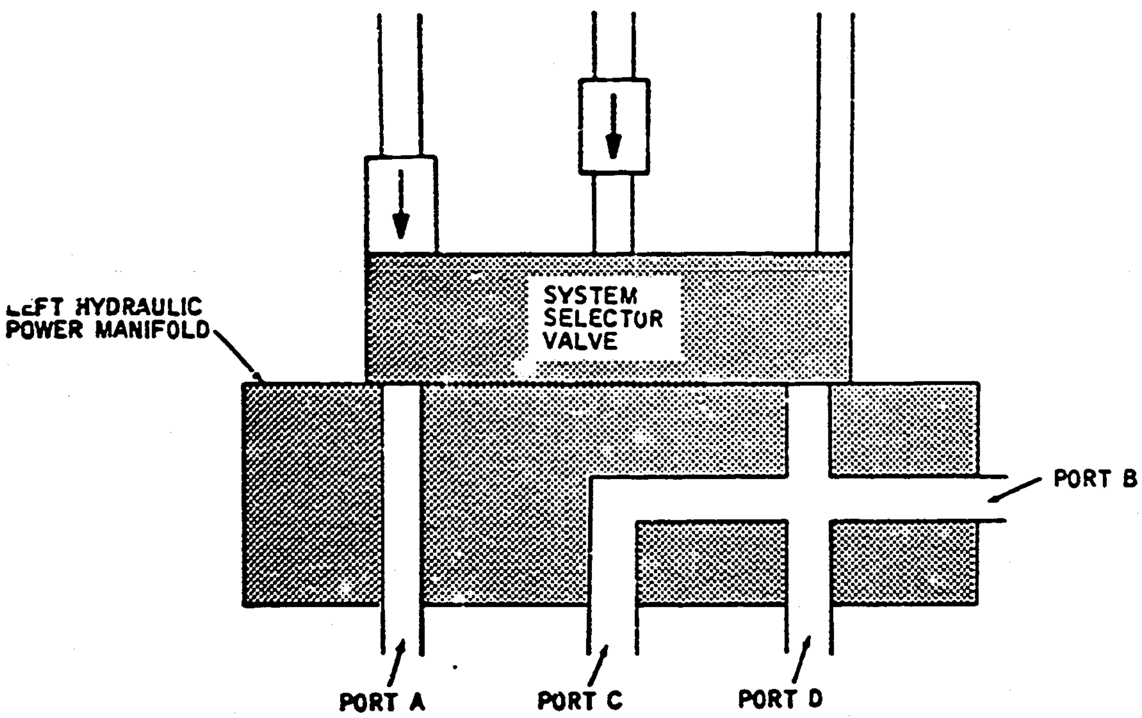


System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17





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Left Hydraulic Power Manifold -- Schematic
Figure 18

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

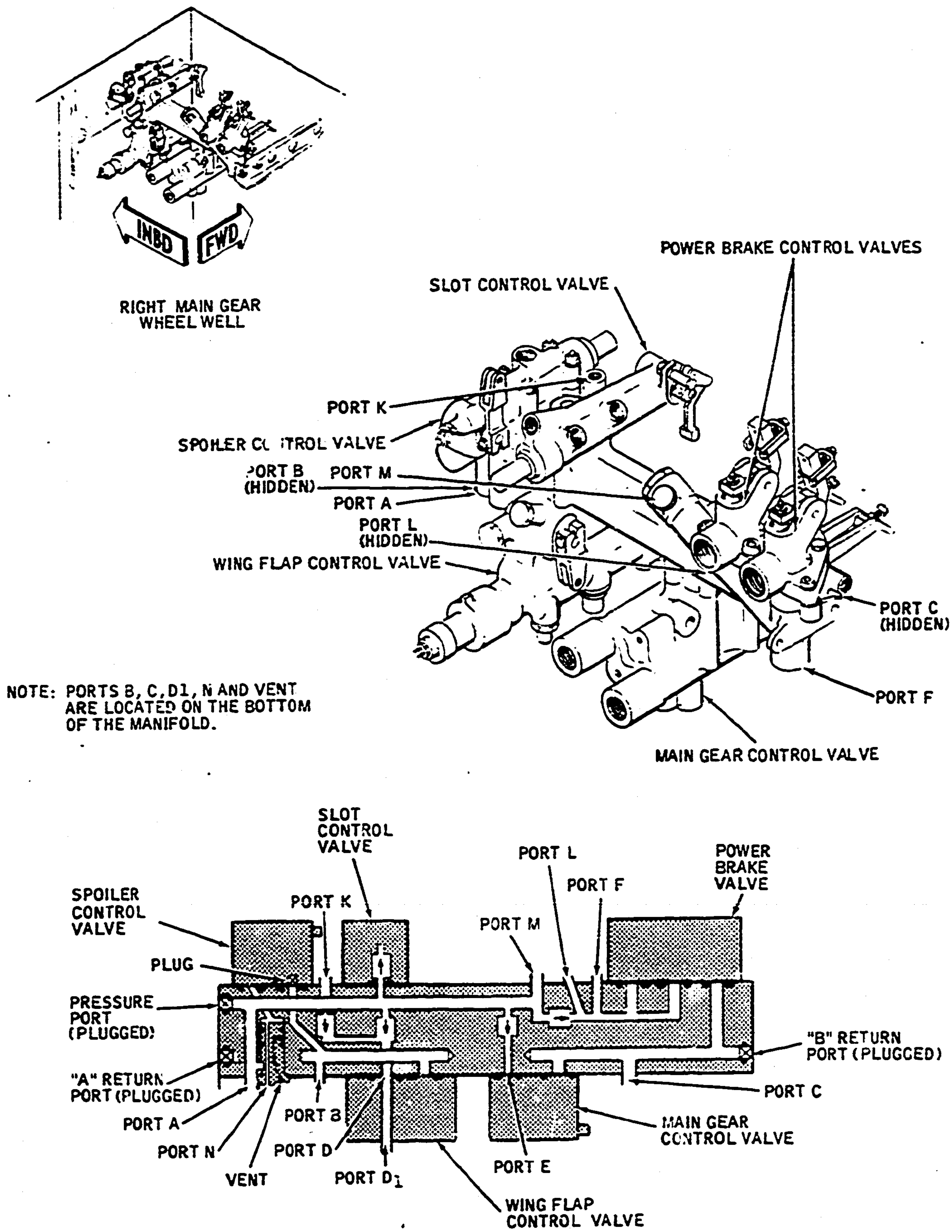
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.



HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19

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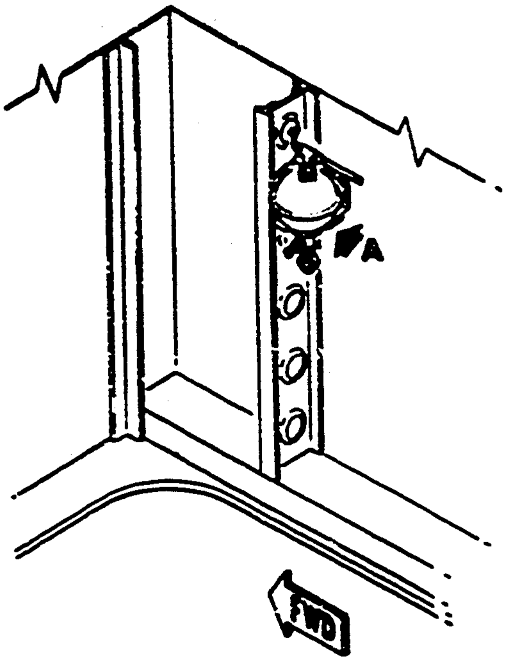
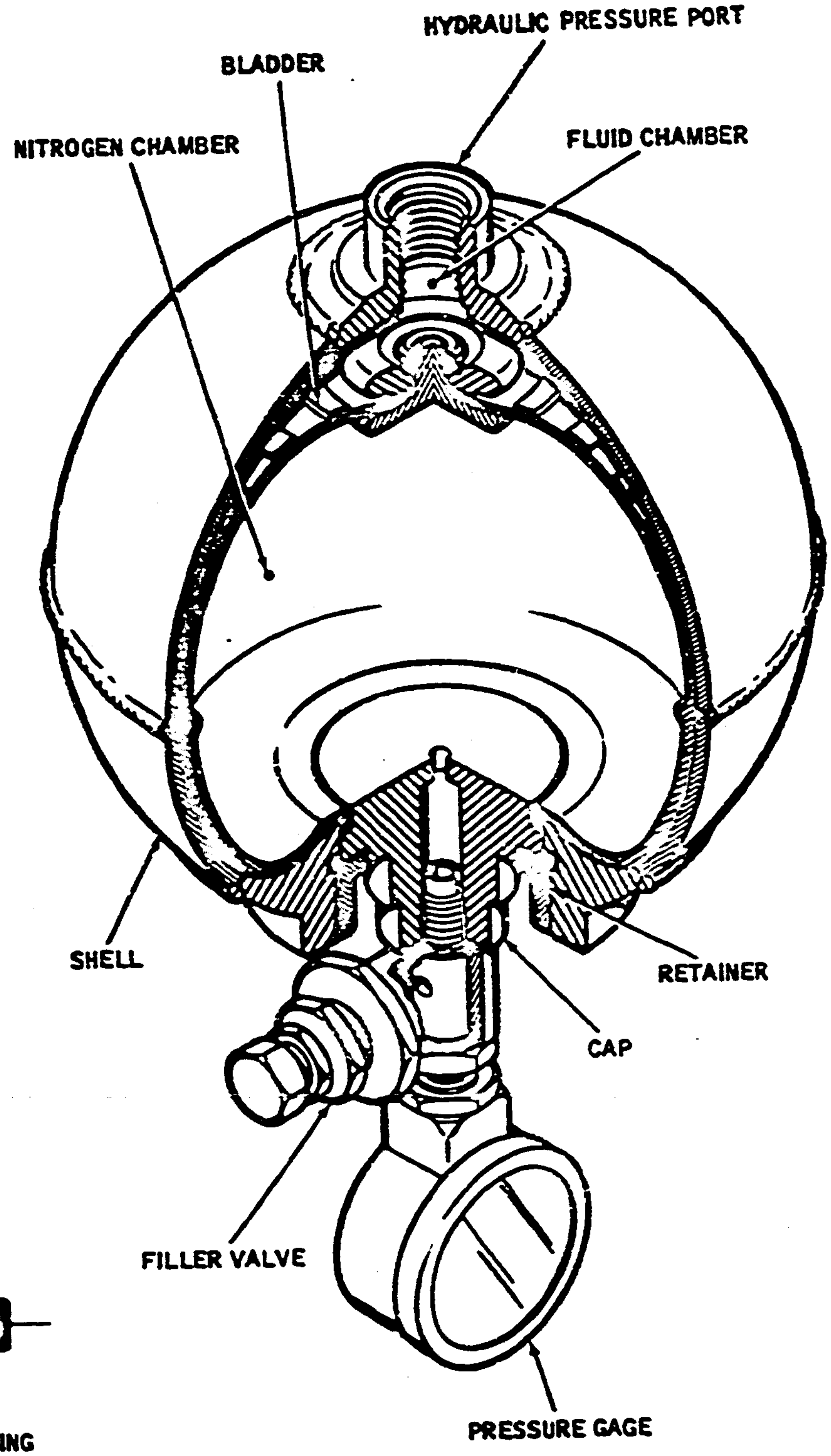
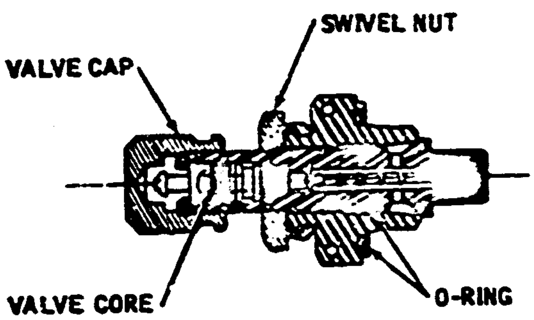


LEFT MAIN GEAR WHEEL WELL



VIEW A



FILLER VALVE

HA2-30

Hydraulic Power System Accumulator -- Cutaway View
Figure 20

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

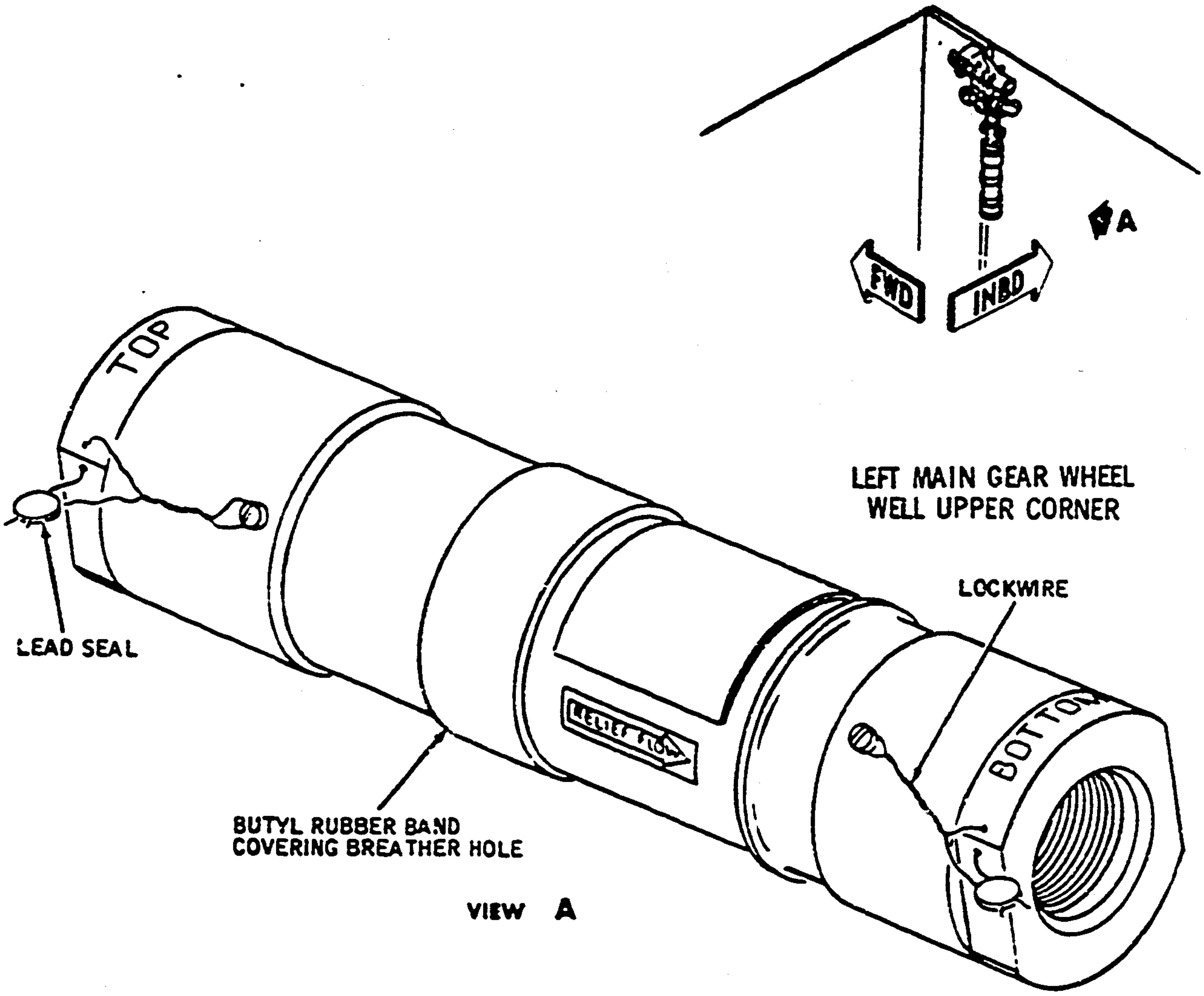
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

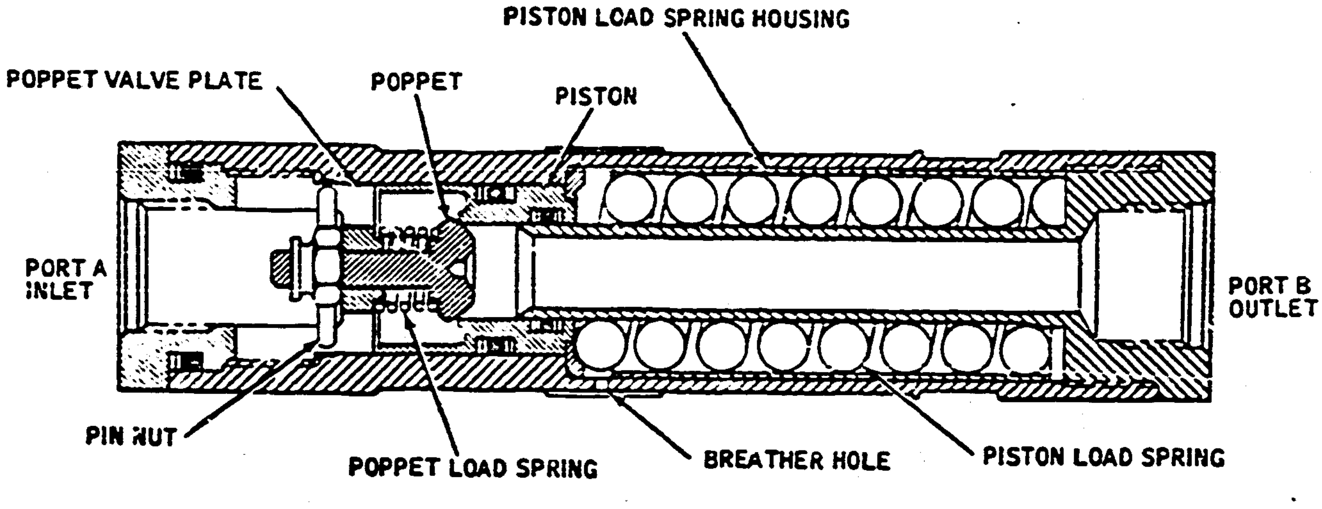
T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and premitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.





Hydraulic System Priority Valve -- Cutaway View
Figure 21

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low stand-pipe in the hydraulic system reservoir. To put the system

into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/flaps only position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector the the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

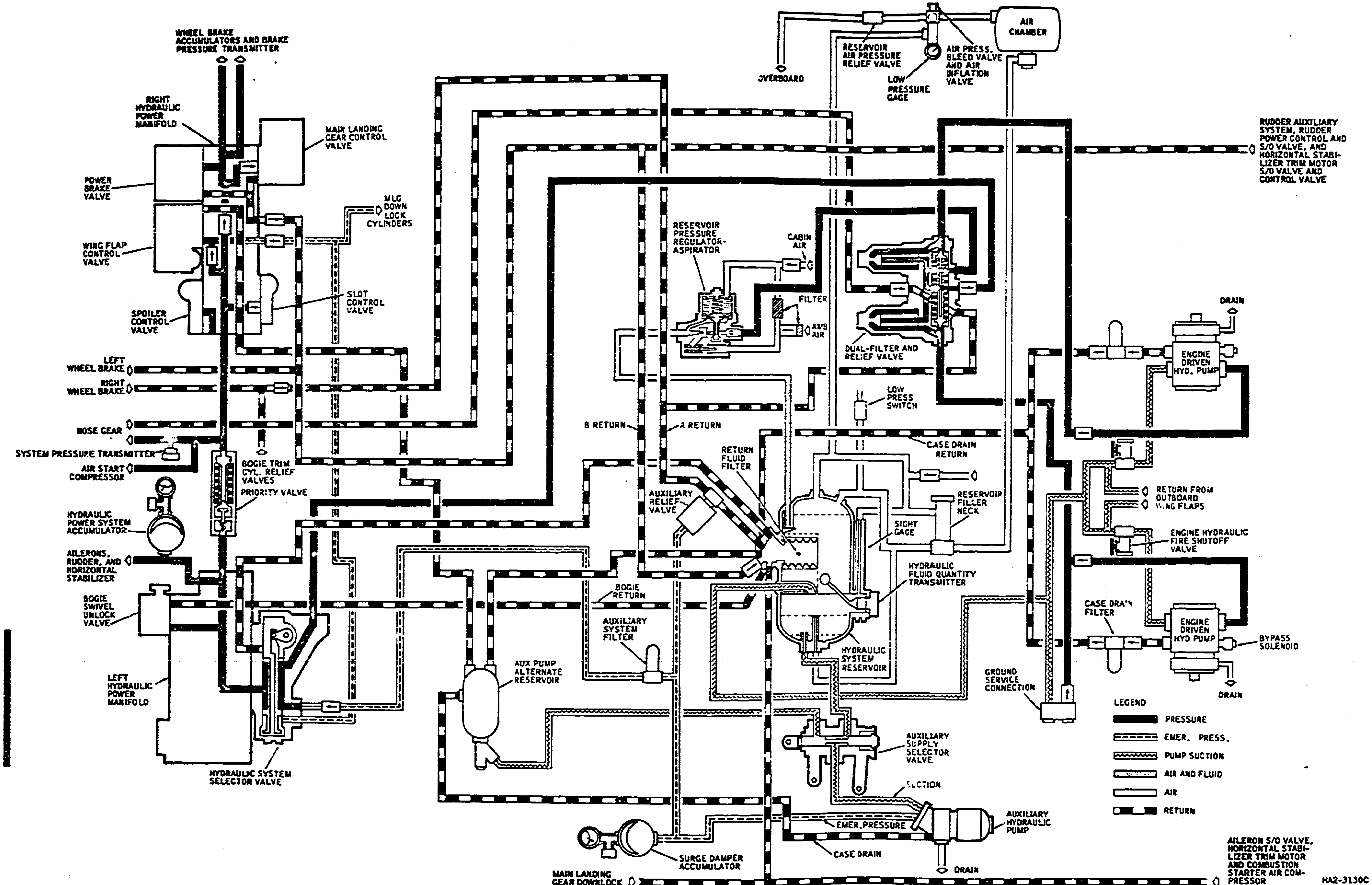
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

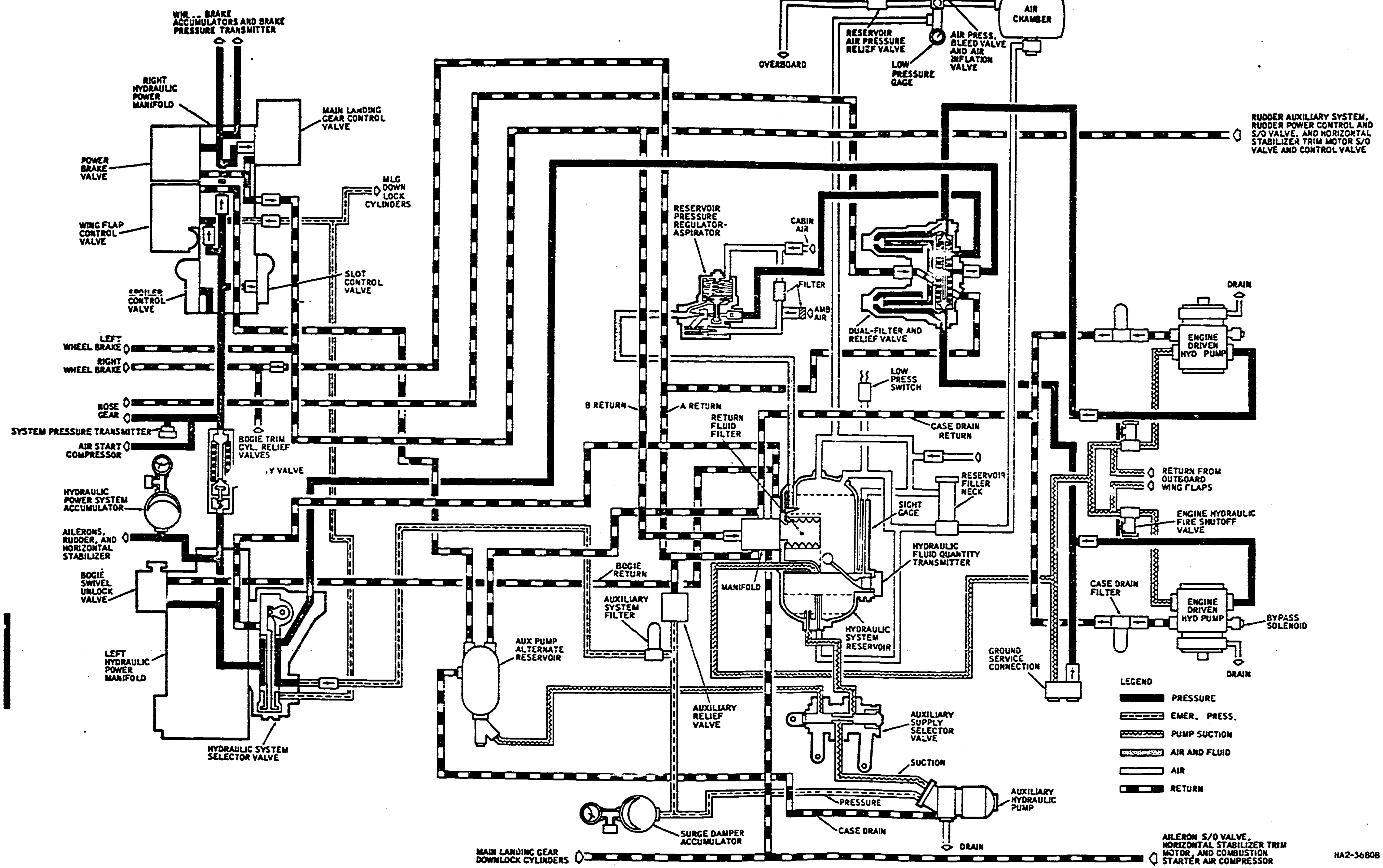
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the



Hydraulic Power System -- Schematic Diagram
(Airplane N8961T)
Figure 1 (Sheet 1)



Hydraulic Power System -- Schematic Diagram
(Airplanes N8960T, N8962T)
Figure 1 (Sheet 2)

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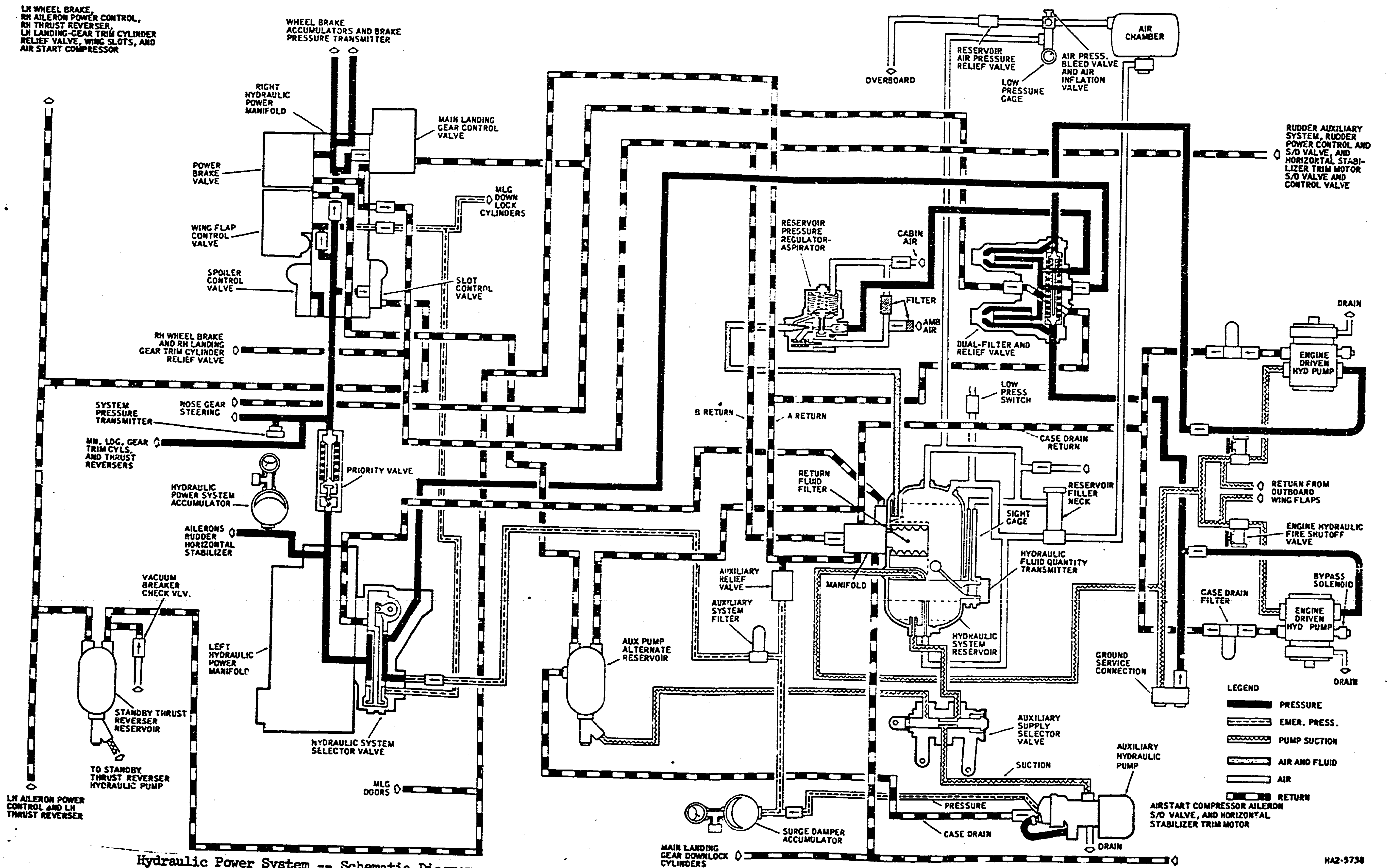

Hydraulic Power System -- Schematic Diagram
(Airplane N4663T and Subsequent)
Figure 1 (Sheet 3)

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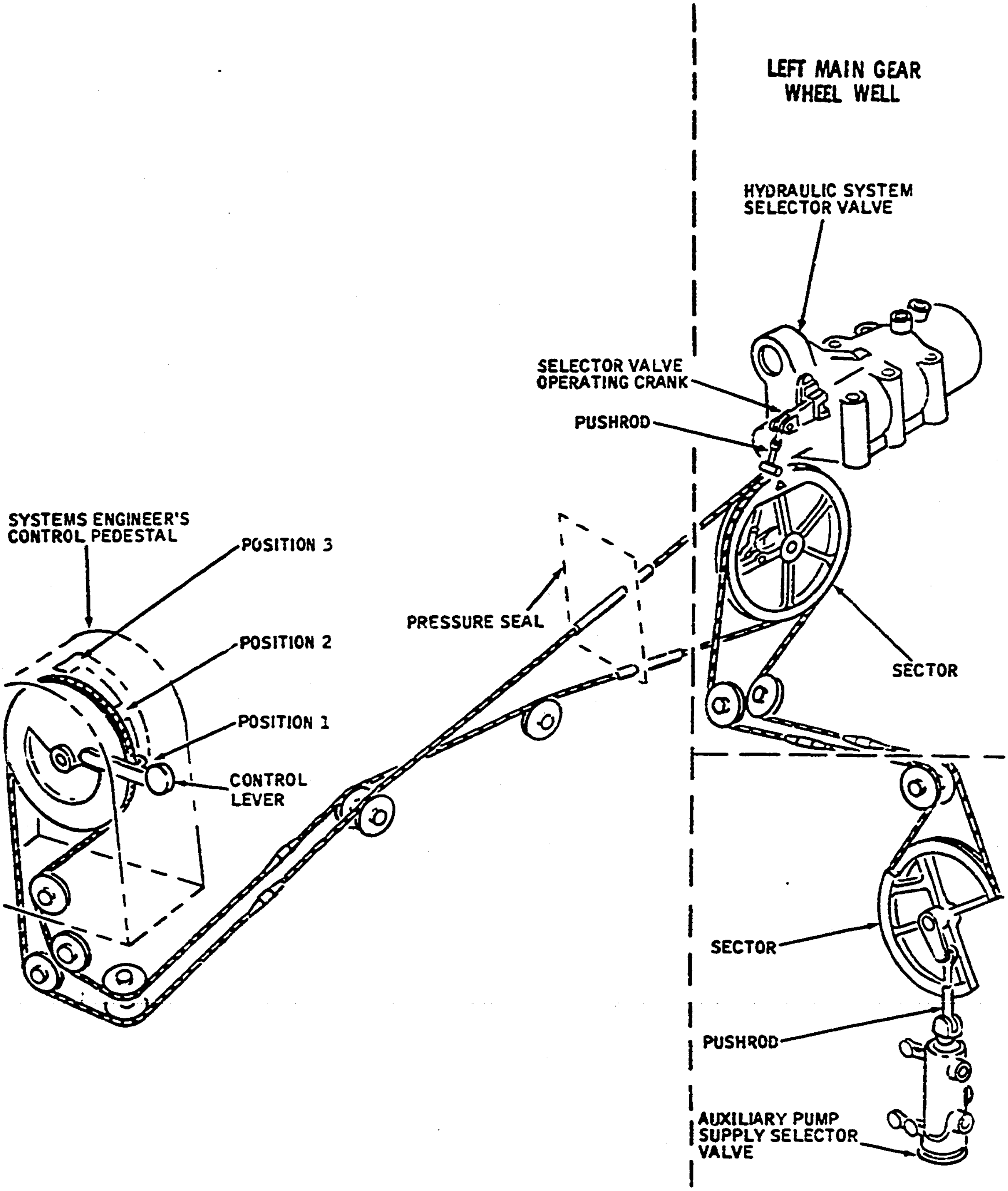


CONTROL POSITIONS

1. BYPASS/GENERAL SYSTEM
2. GENERAL SYSTEM (NORMAL)
3. GENERAL SYSTEM/MAIN GEAR DOWN AND FLAPS

HA2-486

Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure

bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

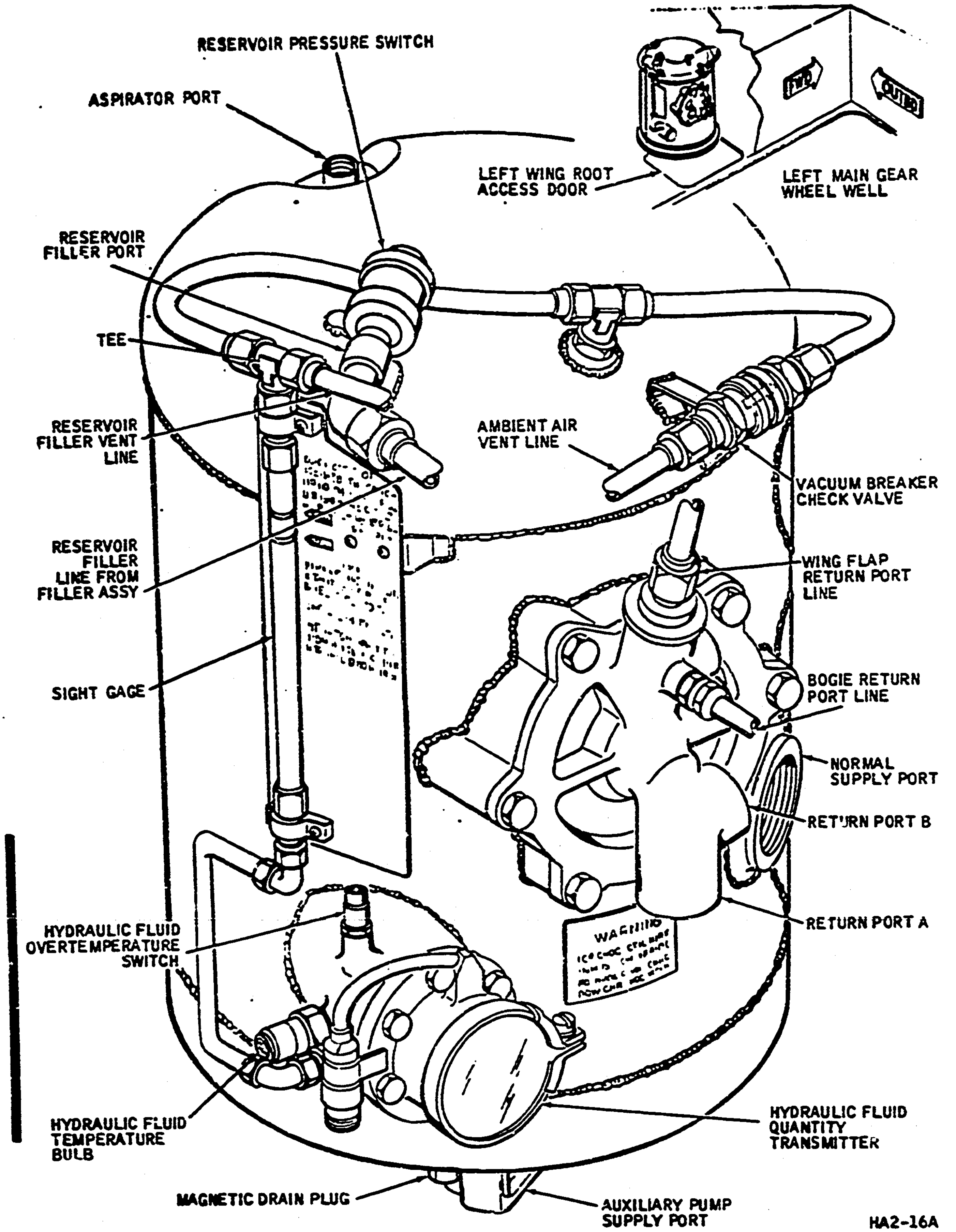
(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

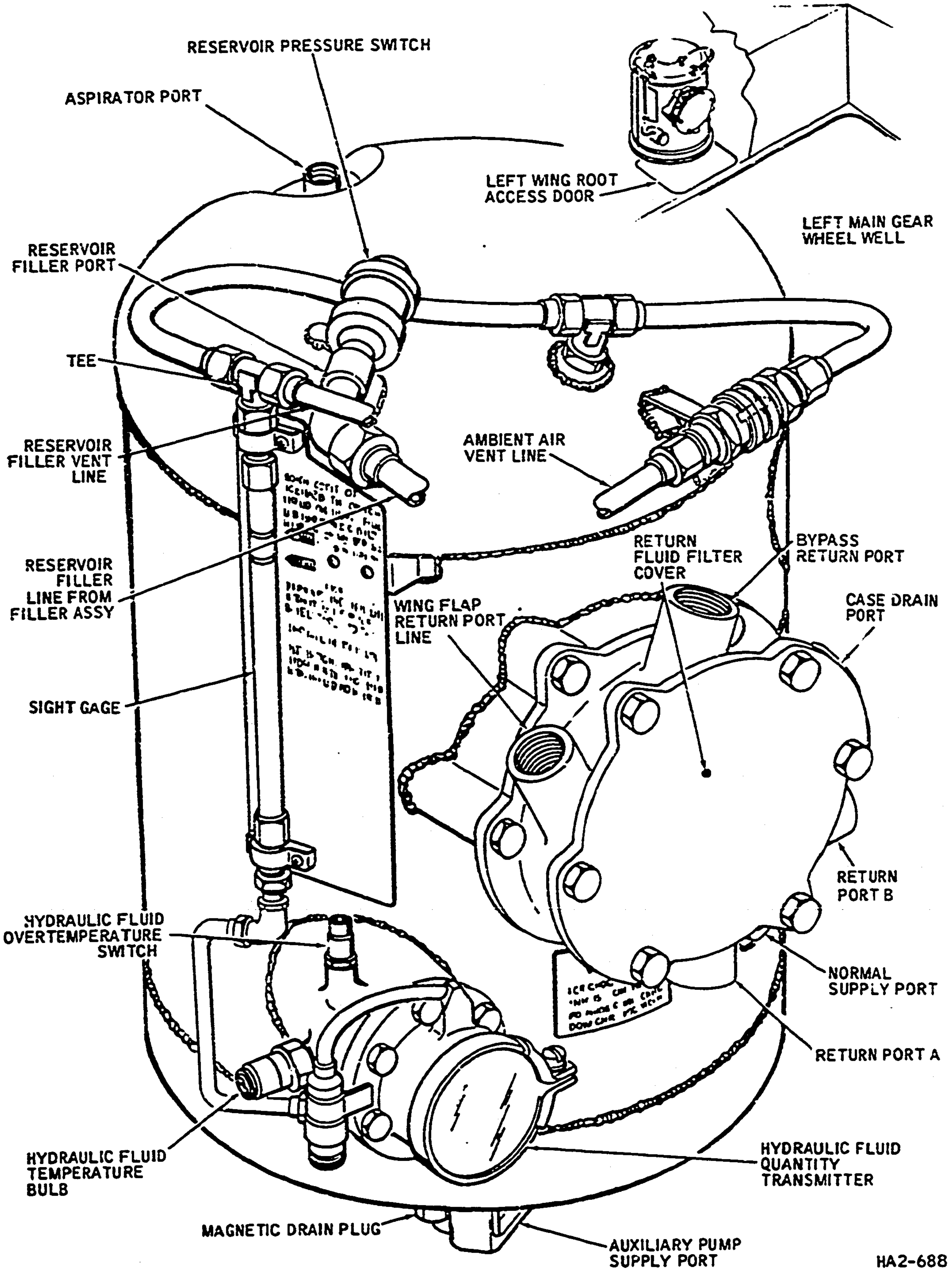
(4) On airplane N8961T the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The manifold is bolted to the flange and contains five ports: return port A, located at the bottom; return port B, located at the lower right side; the low-pressure return port, located at the upper right; the wing flap return port, located at the top; and the bogie return port, located on the face of the manifold just below the wing flap return port.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the manifold holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) On airplanes N8960T, N8962T and subsequent, the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting



Hydraulic System Reservoir -- External View
(Airplane N8961T)
Figure 3 (Sheet 1)



Hydraulic System Reservoir -- External View
(Airplanes N8960T, N8962T, N4863T and Subsequent)
Figure 3 (Sheet 2)

flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(7) The return fluid filter is installed in the reservoir behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

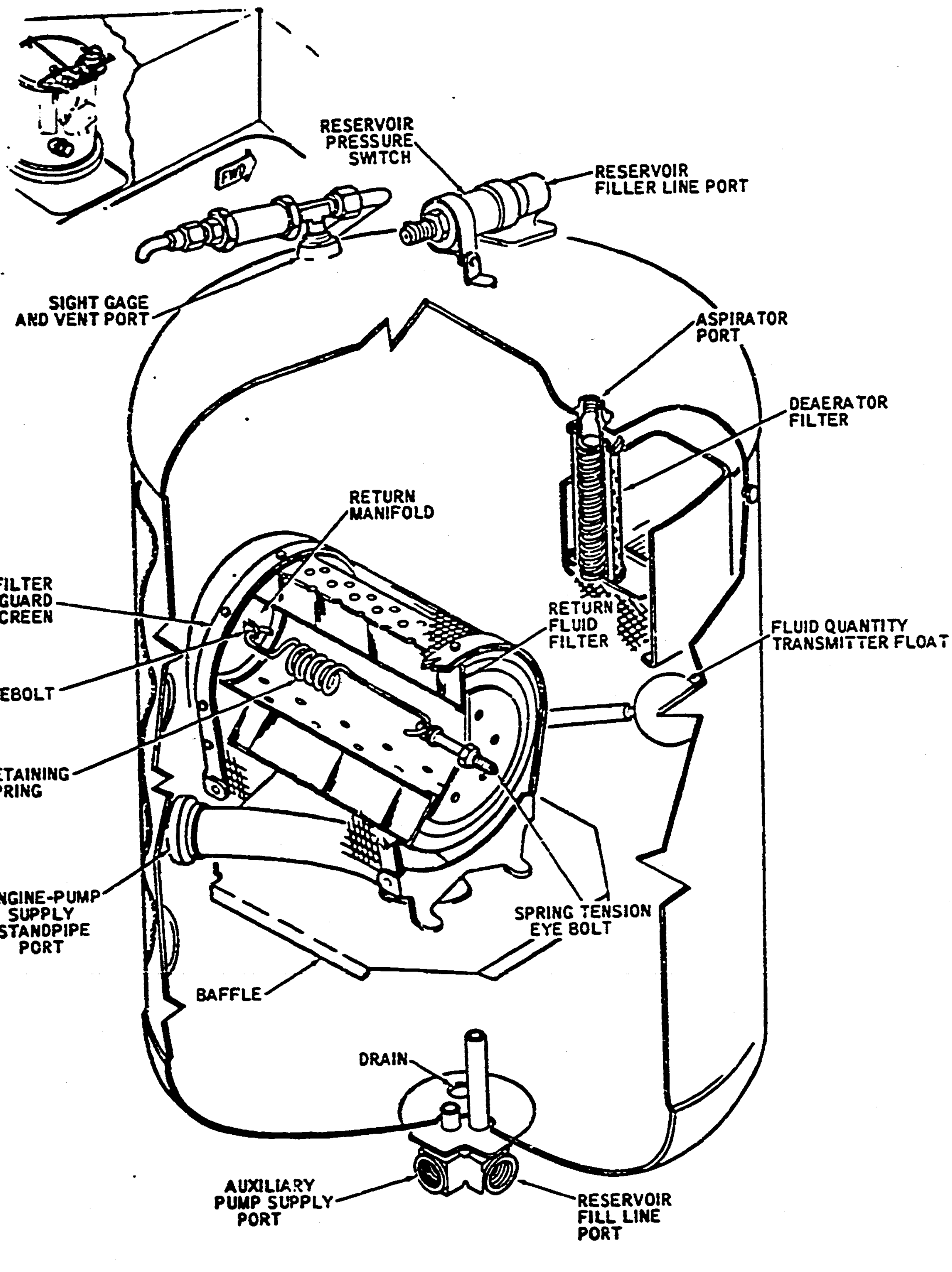
(8) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold and is spring loaded to act as its own relief valve. On airplane N8961T access to the filter is by removing the return ports manifold. Removal of the return ports manifold necessitates disconnecting the return lines from the manifold and removal of six bolts which secure the manifold to the reservoir. The filter which is attached to the manifold is then withdrawn from the reservoir. On airplanes N8960T, N8962T and subsequent access to the filter is gained by removing the return filter cover from the return ports manifold by removal of six bolts. The filter is attached to the cover by a retaining spring, and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold. The spring passes through the center



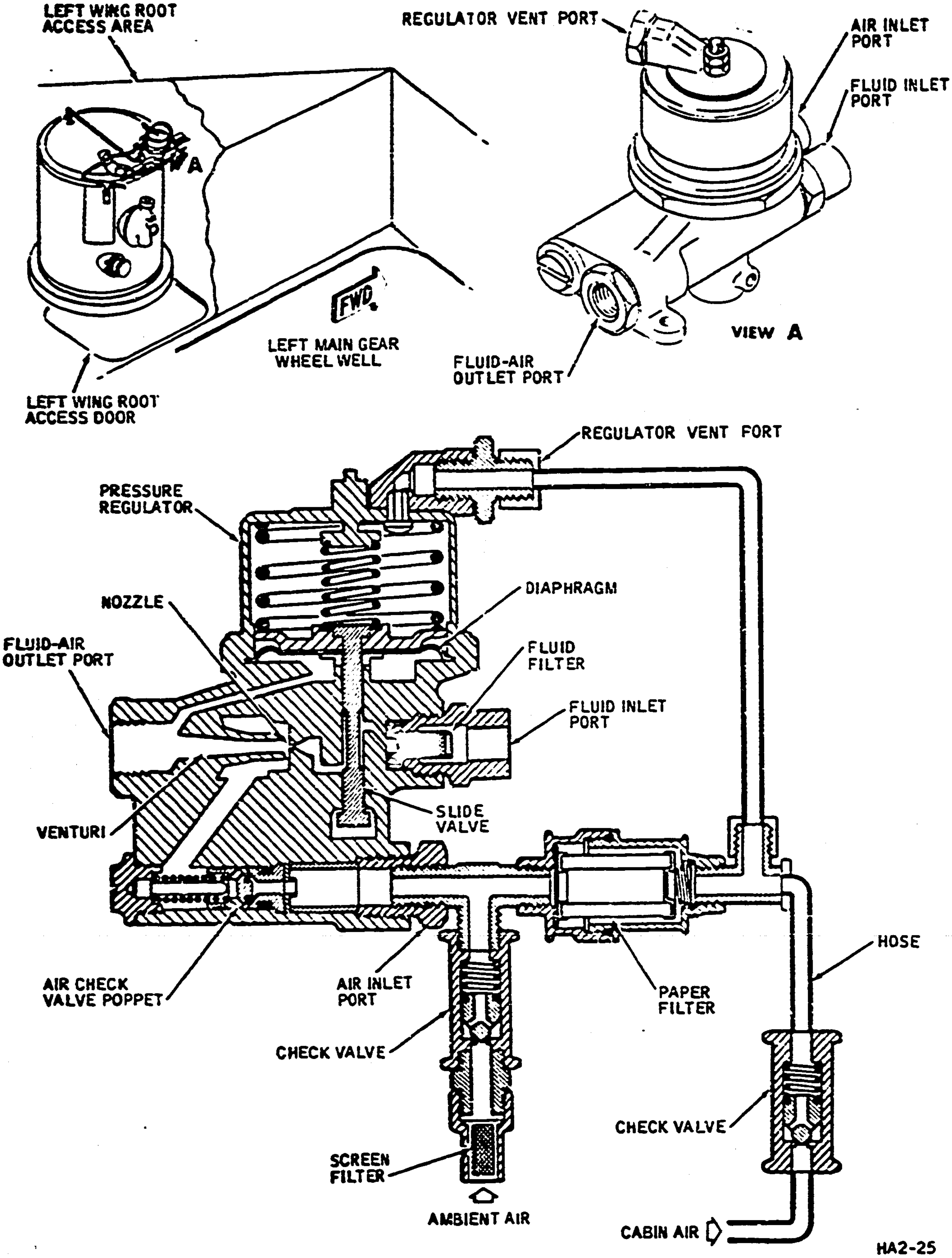
Hydraulic System Reservoir -- Cutaway View
Figure 4

chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

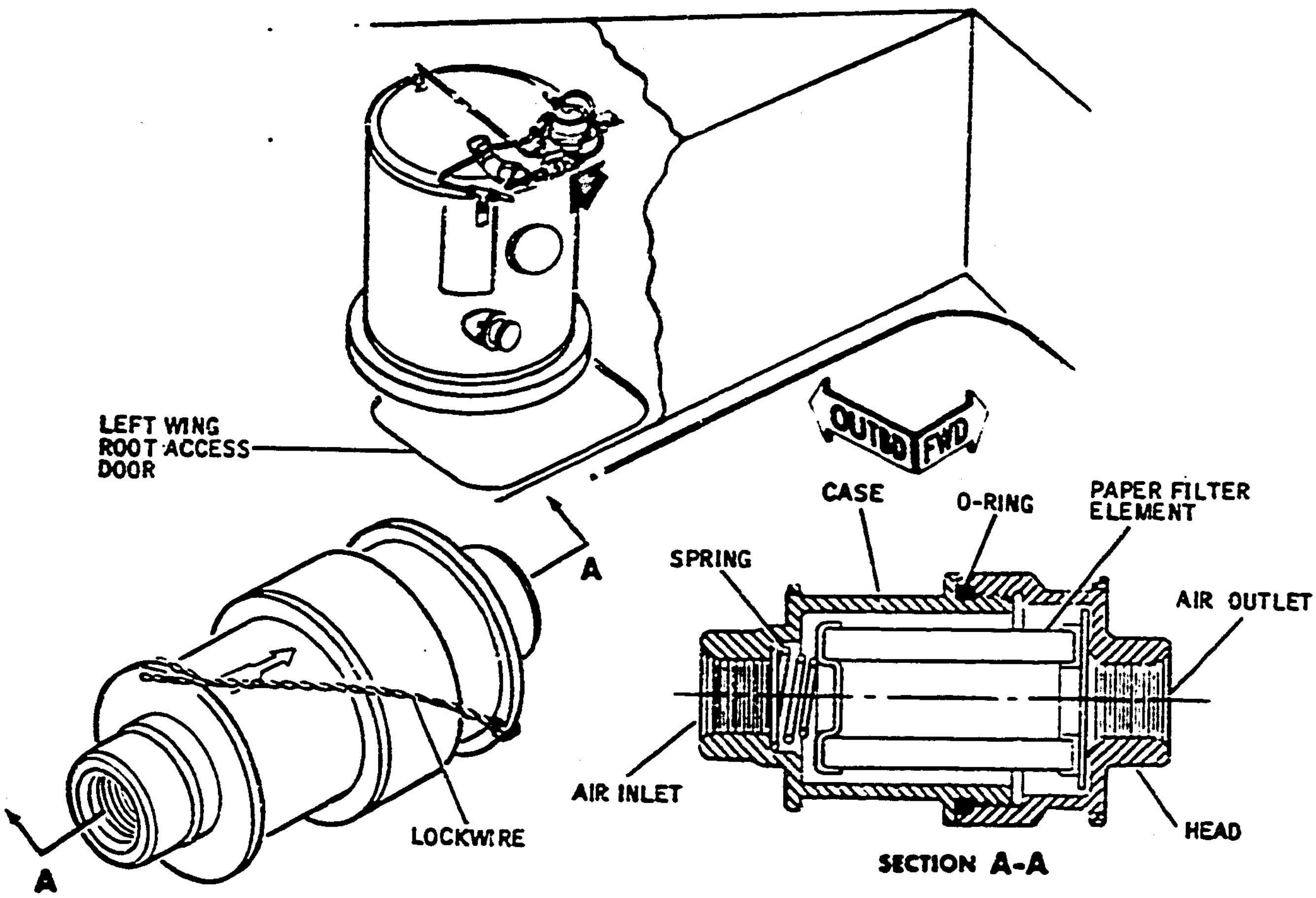
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm that would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removed smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.



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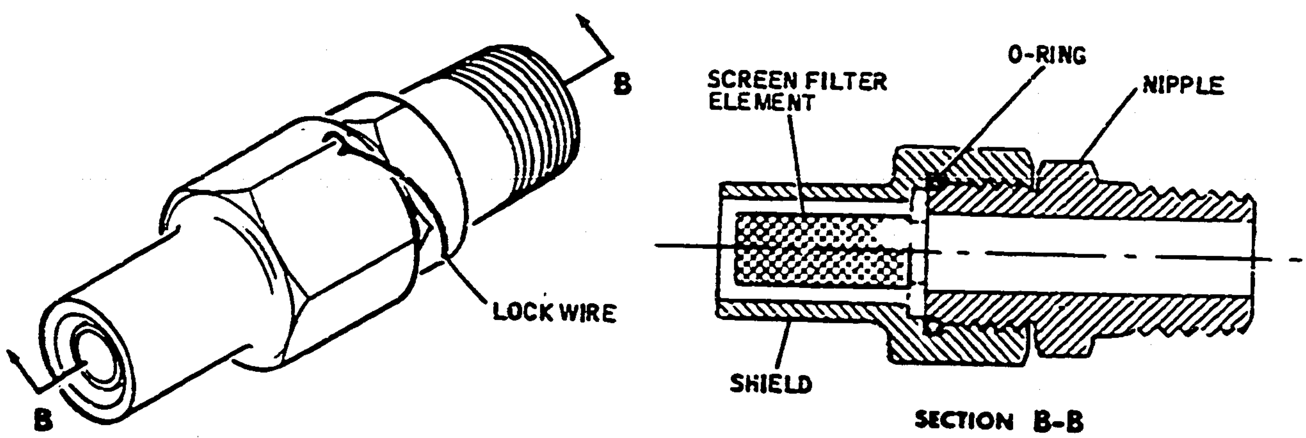

SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber.

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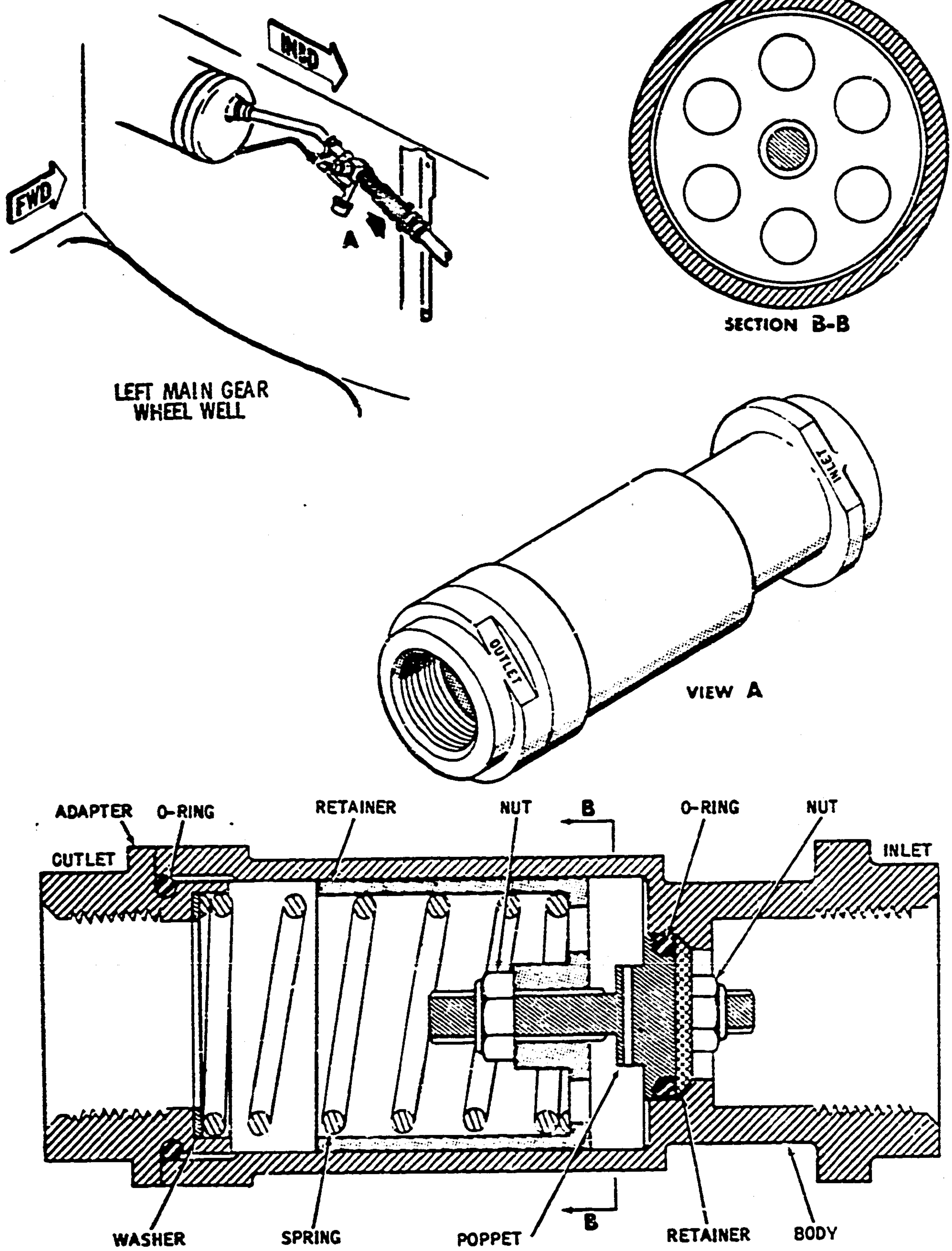

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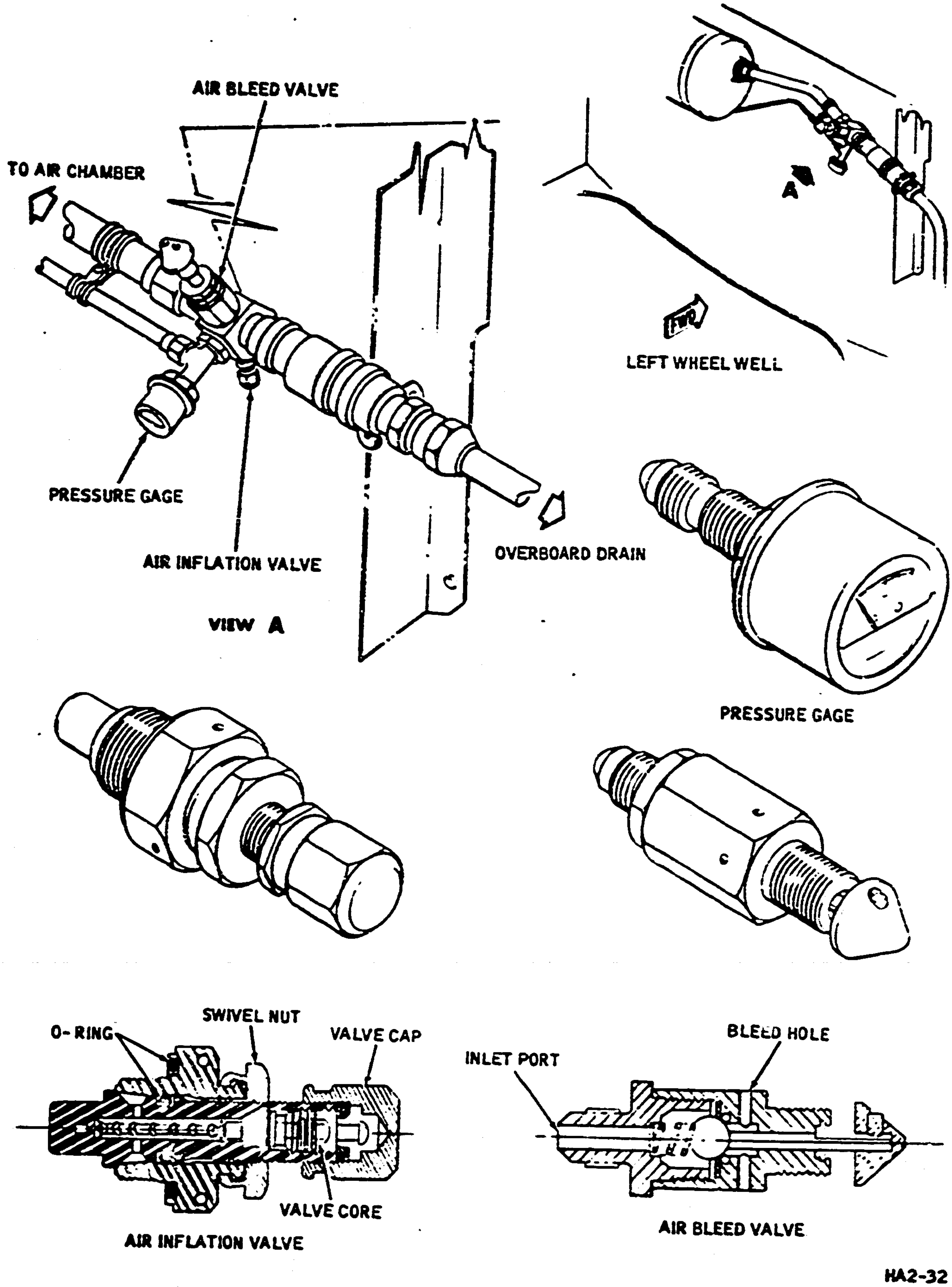
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8

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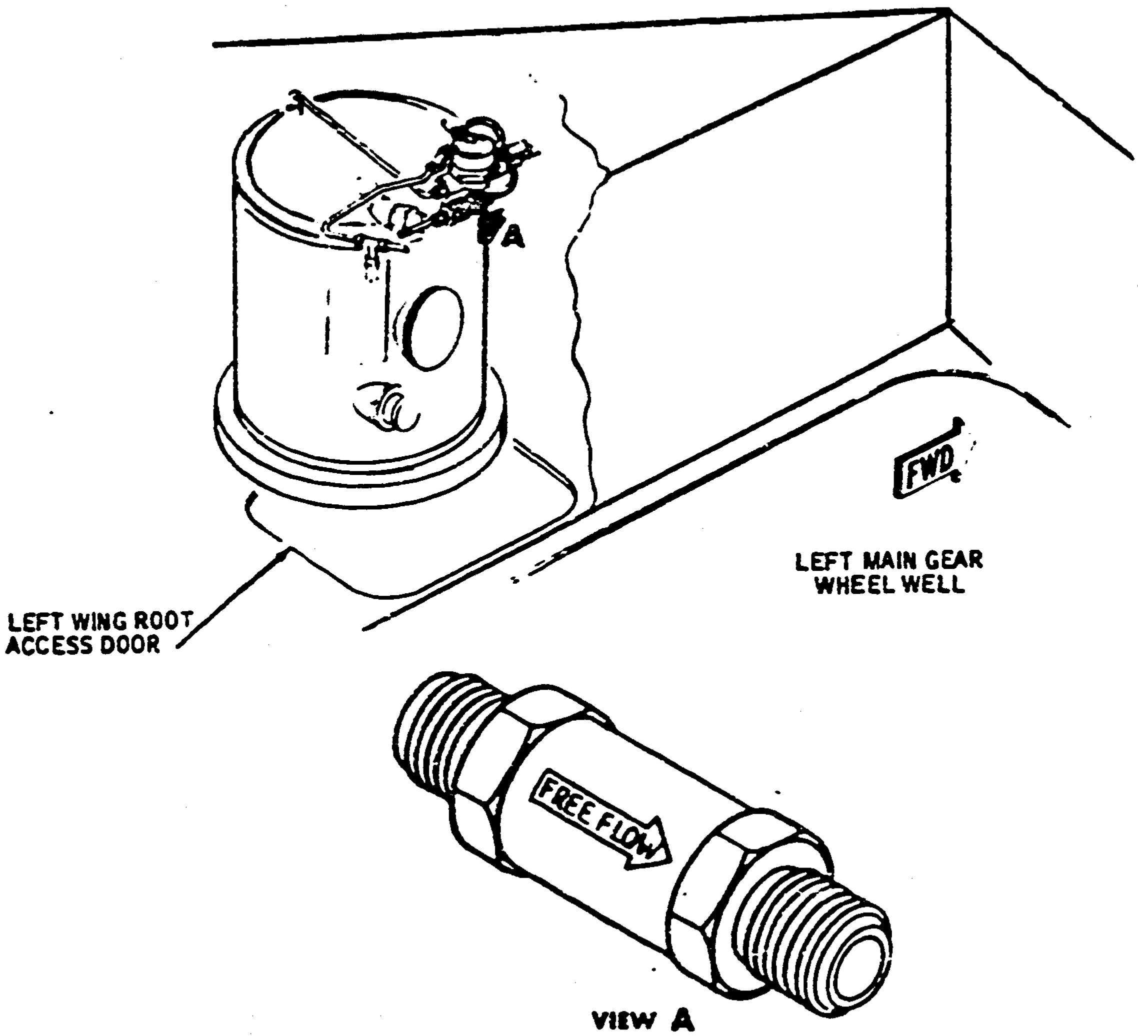
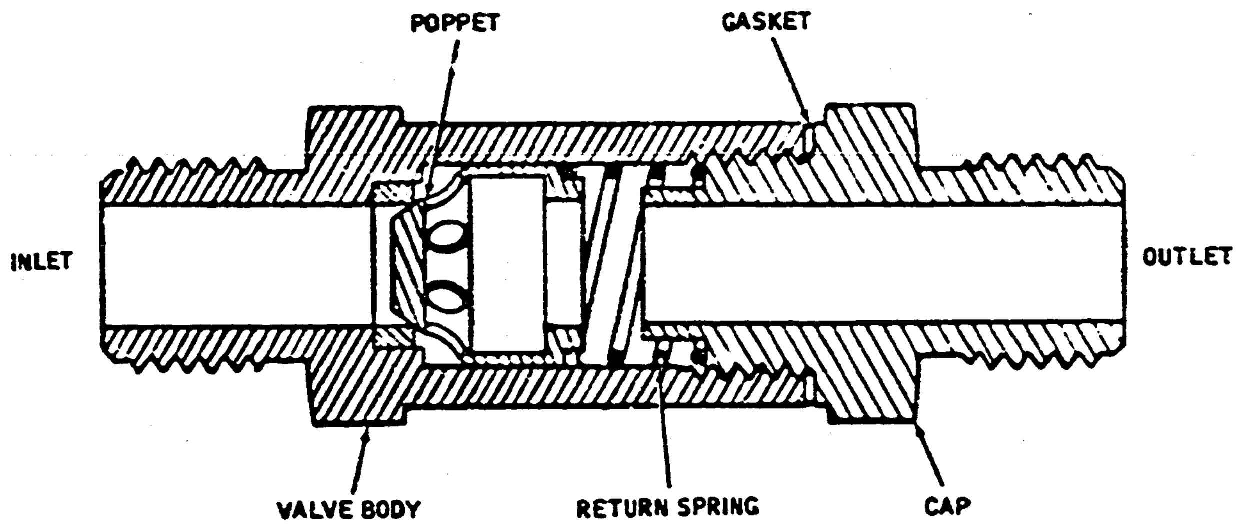




HA2-33

Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

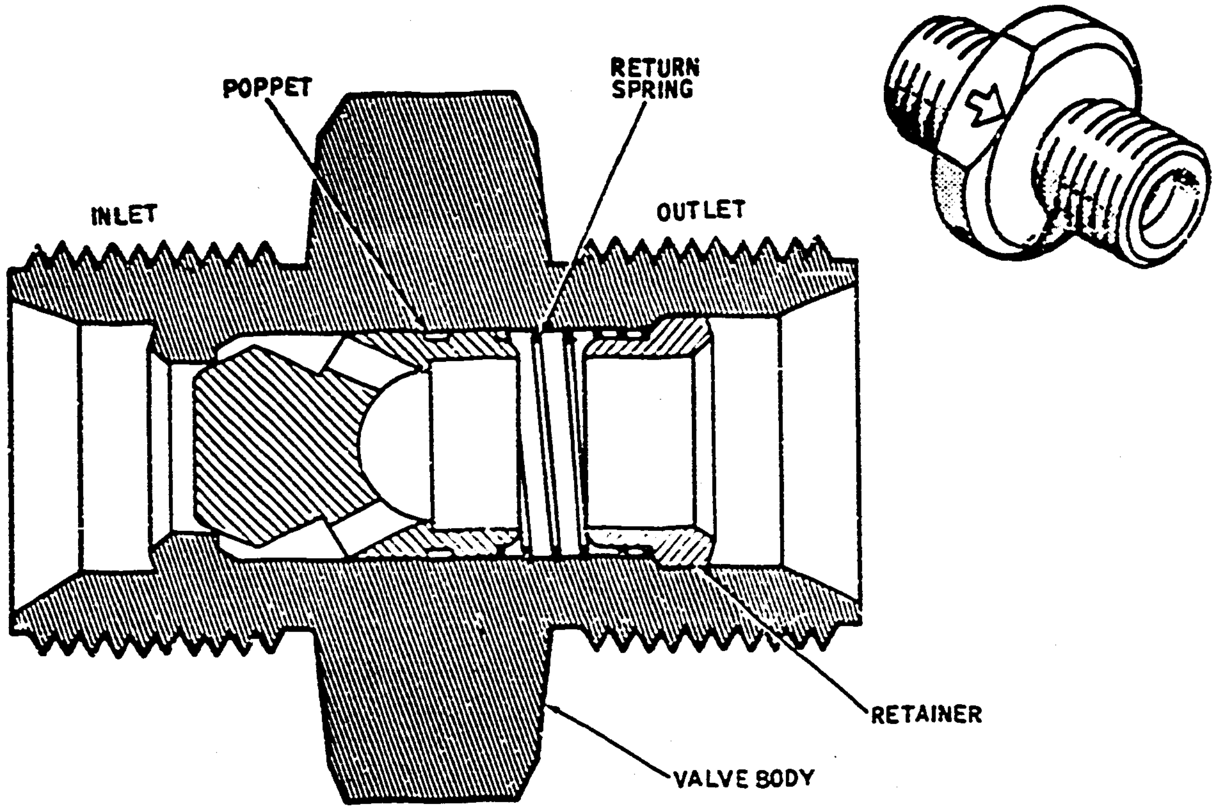
(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

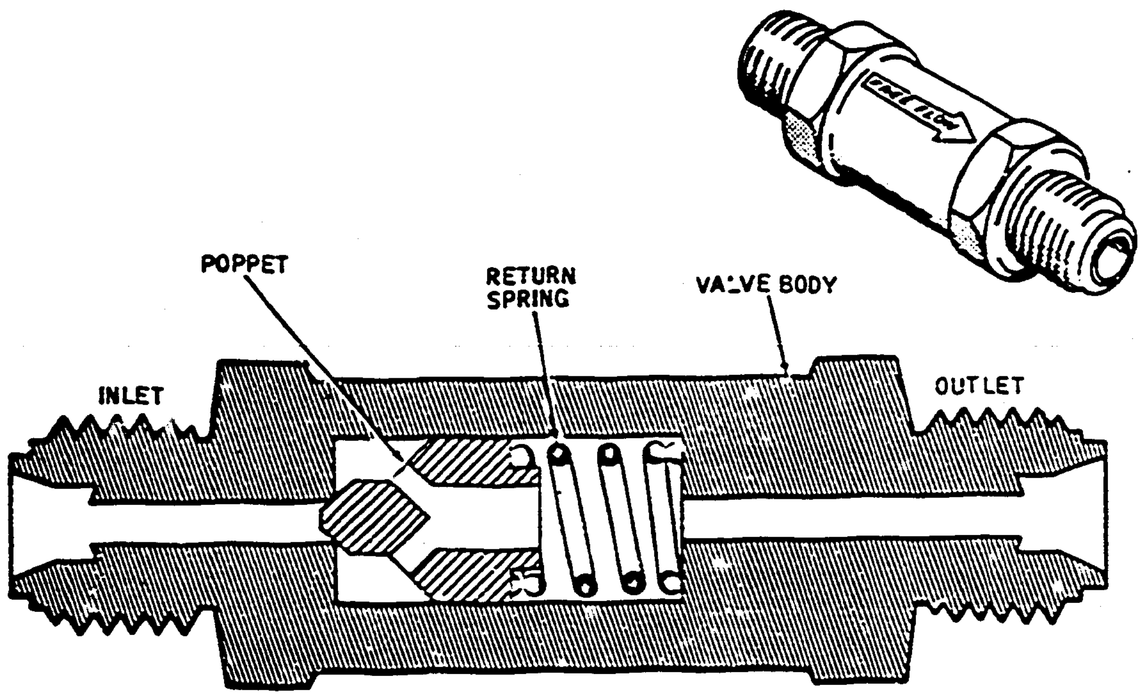
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.



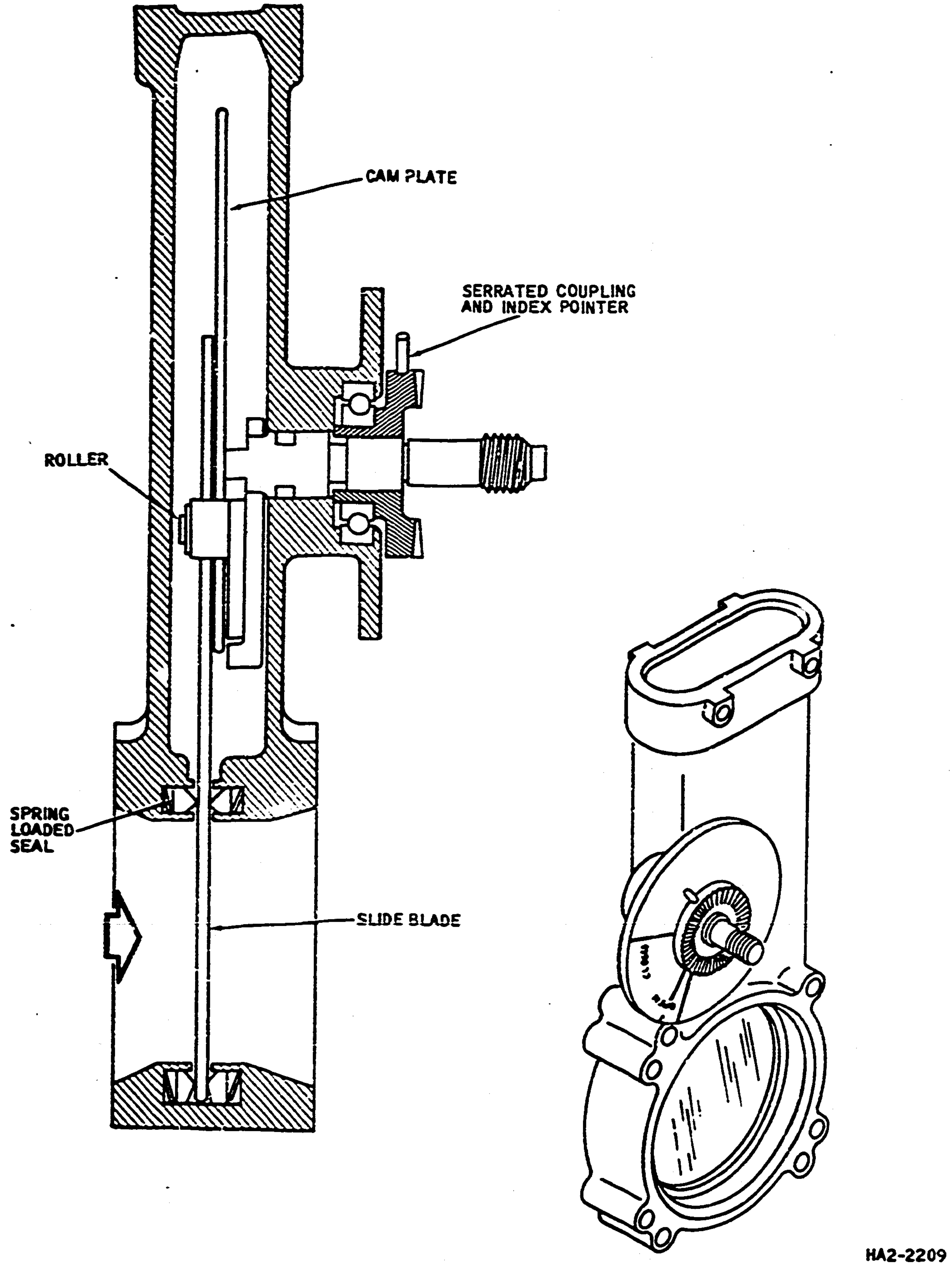
MINIATURE CHECK VALVE



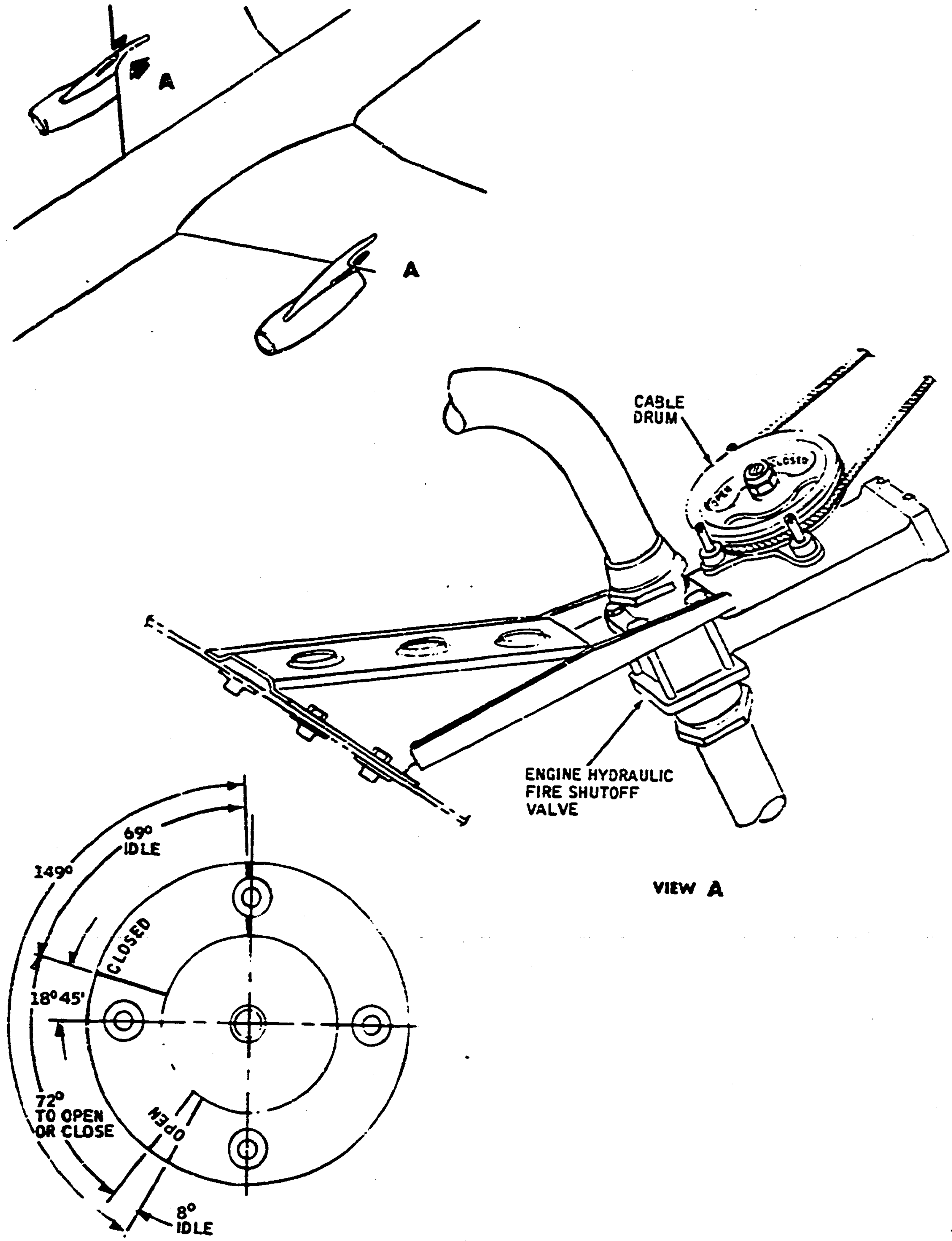
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



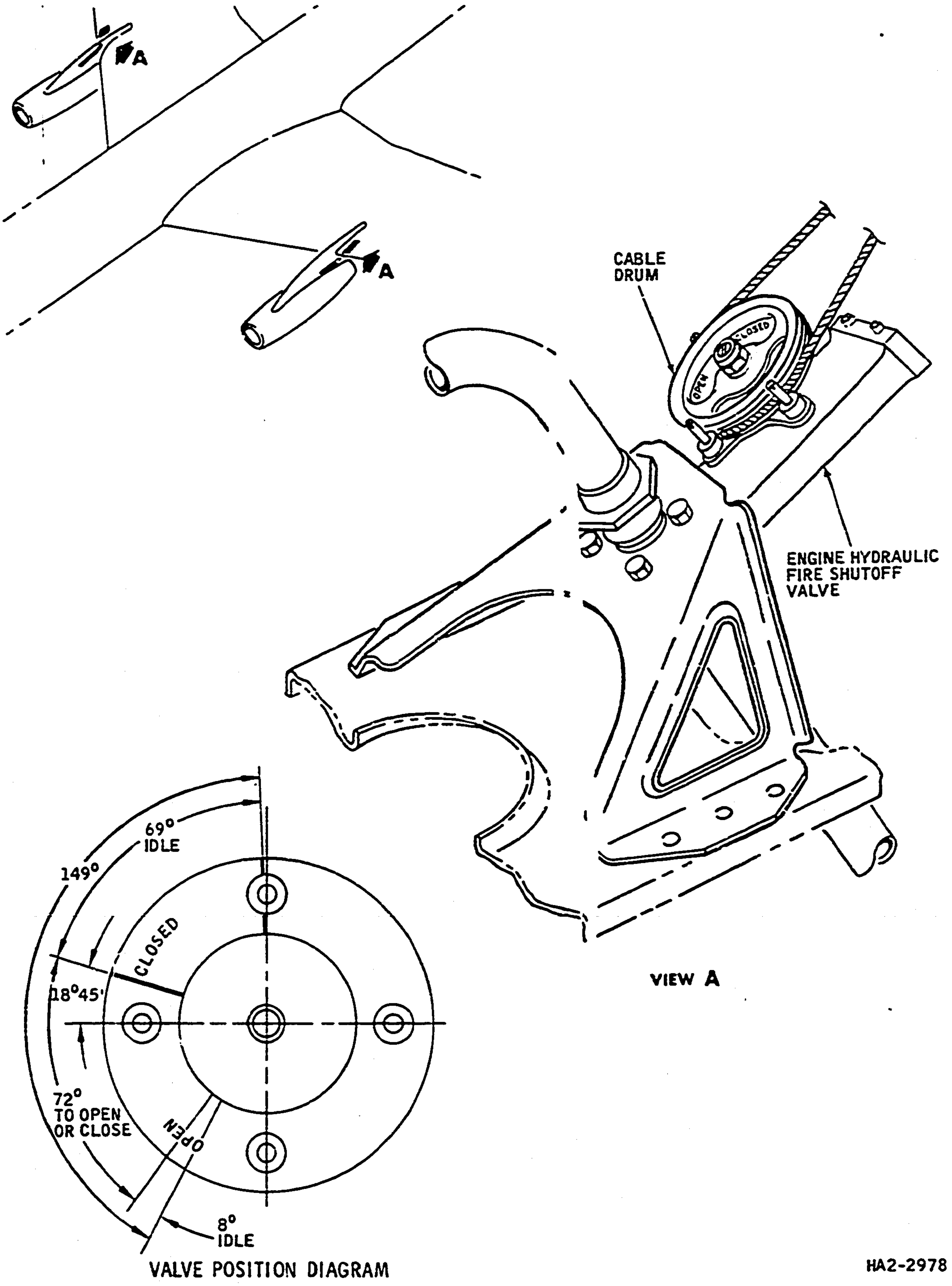
Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



VALVE POSITION DIAGRAM

HA2-22

Engine Hydraulic Fire Shutoff Valve
(Airplanes N8960T-N8962T)
Figure 12 (Sheet 1)



Engine Hydraulic Fire Shutoff Valve
(Airplane N4863T and Subsequent)
Figure 12 (Sheet 2)

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

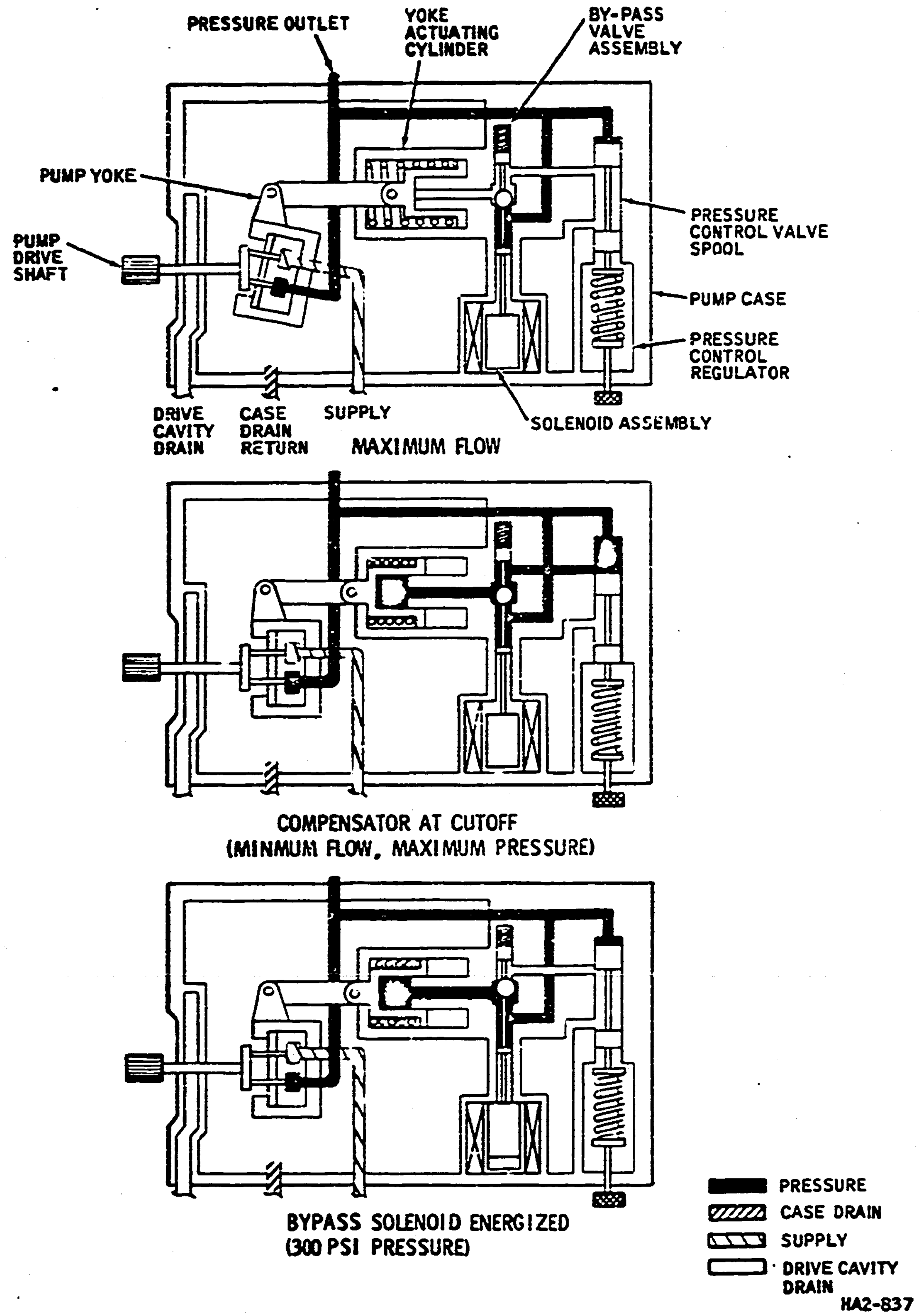
(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending though the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

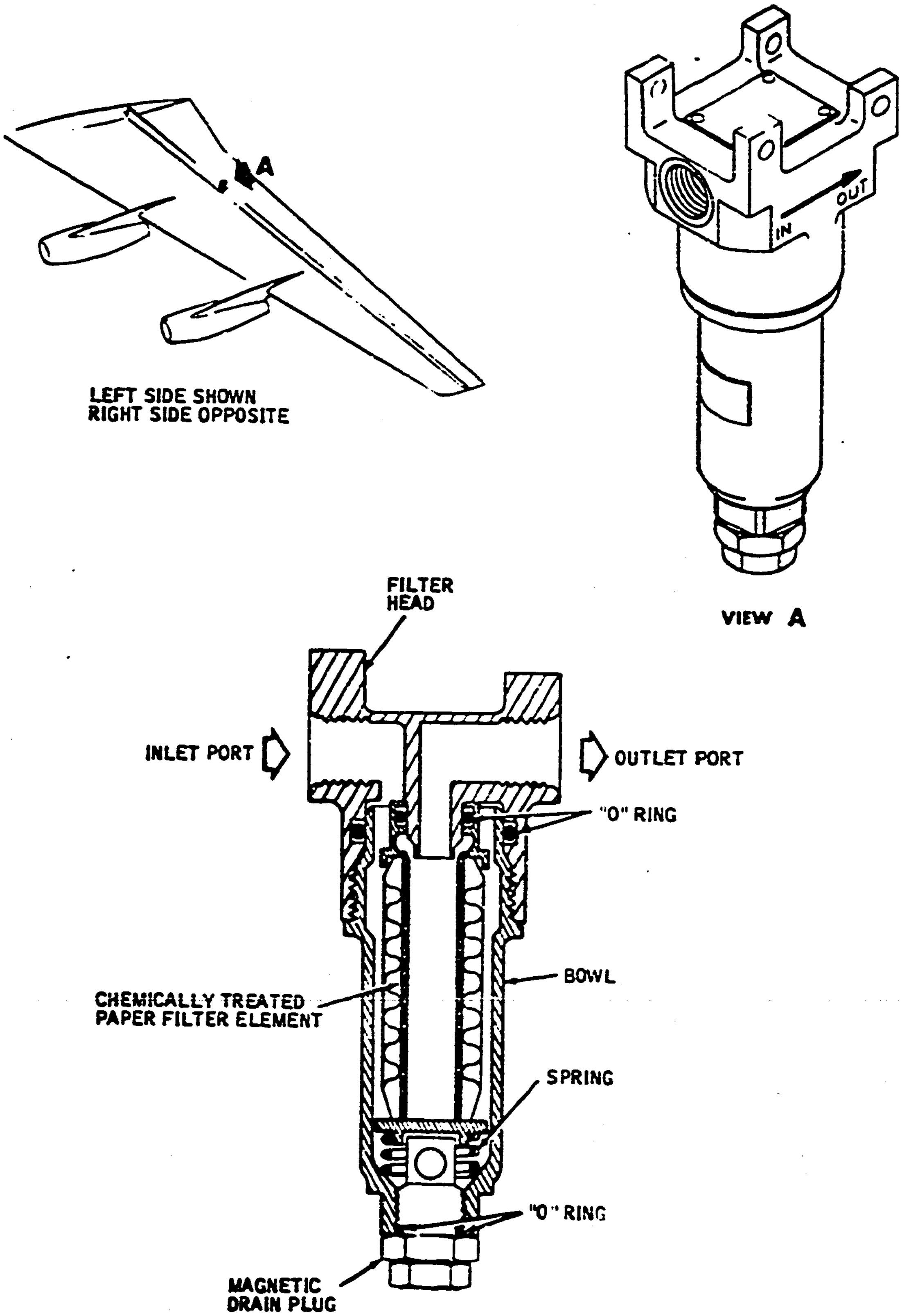
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



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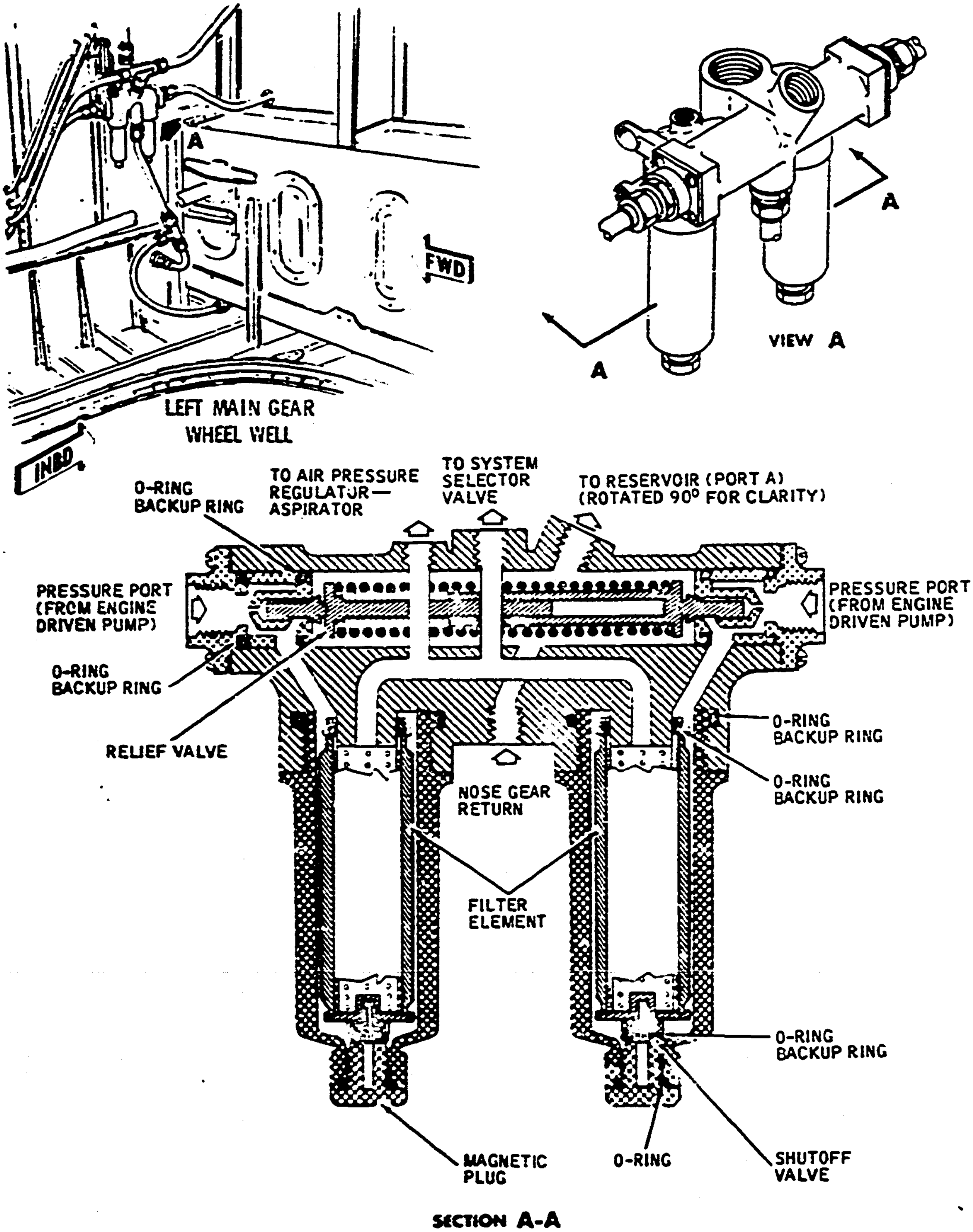
Engine-Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



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Dual Filter and Relief Valve -- Cutaway View
Figure 15

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

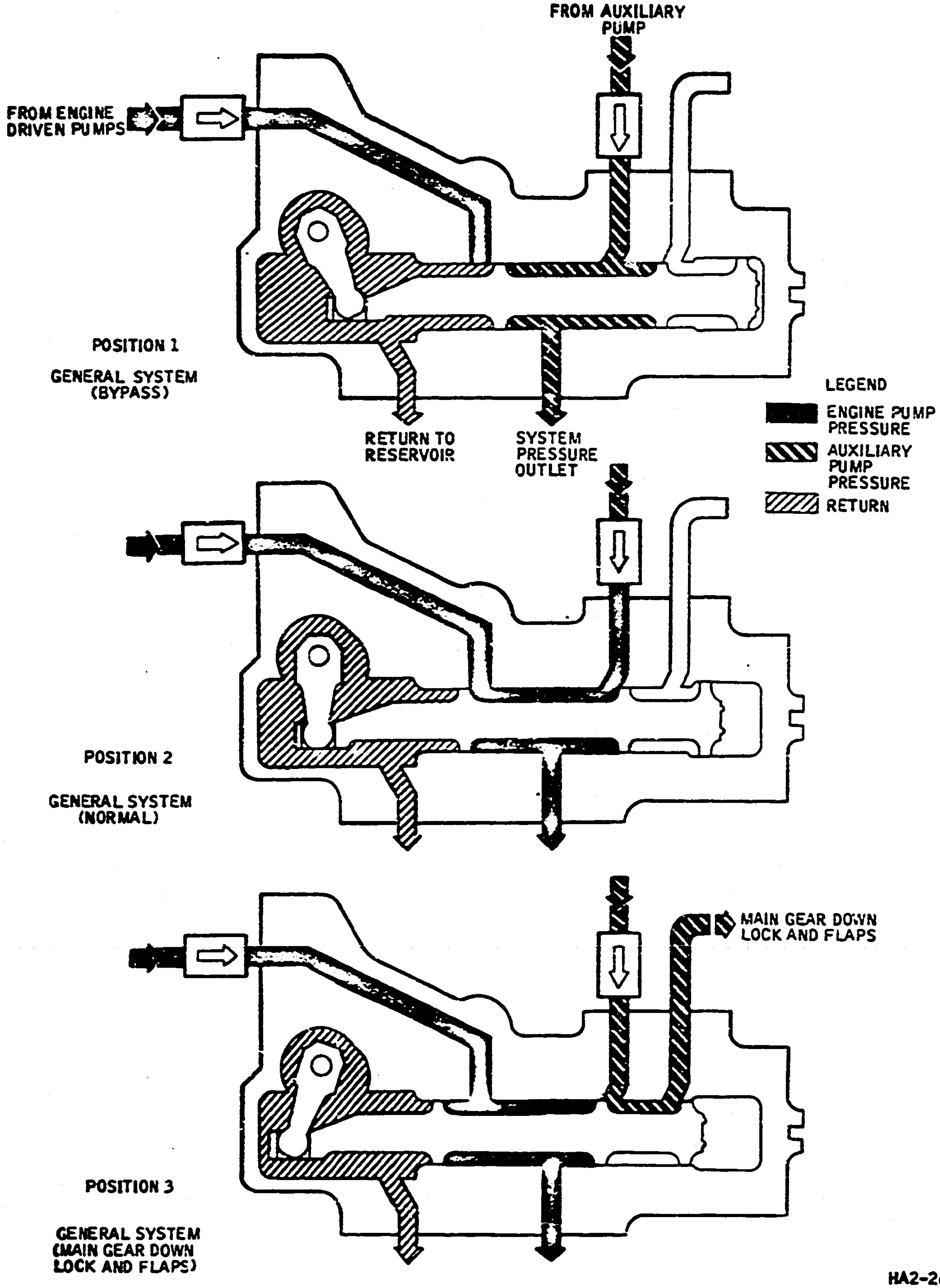
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

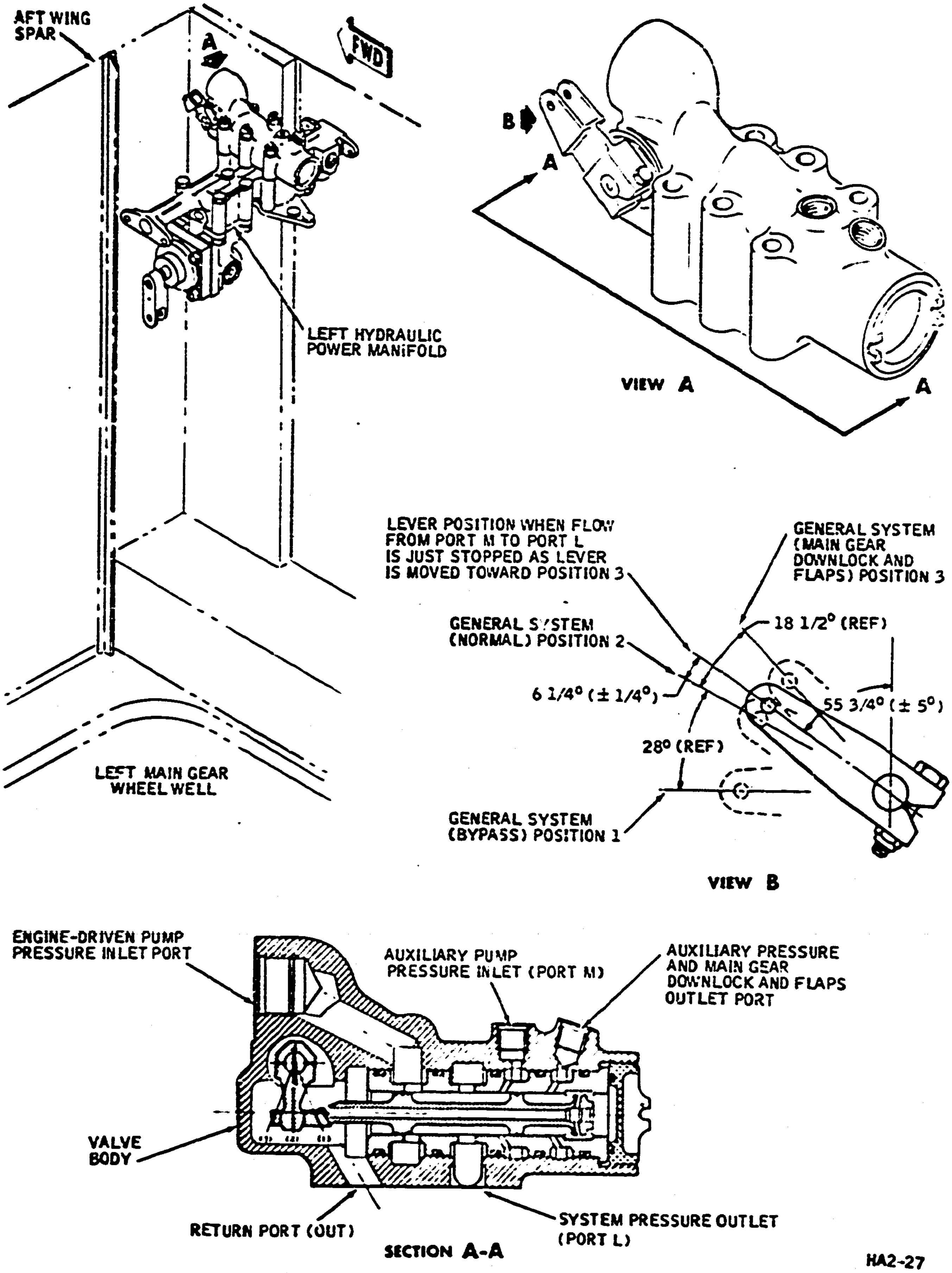
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

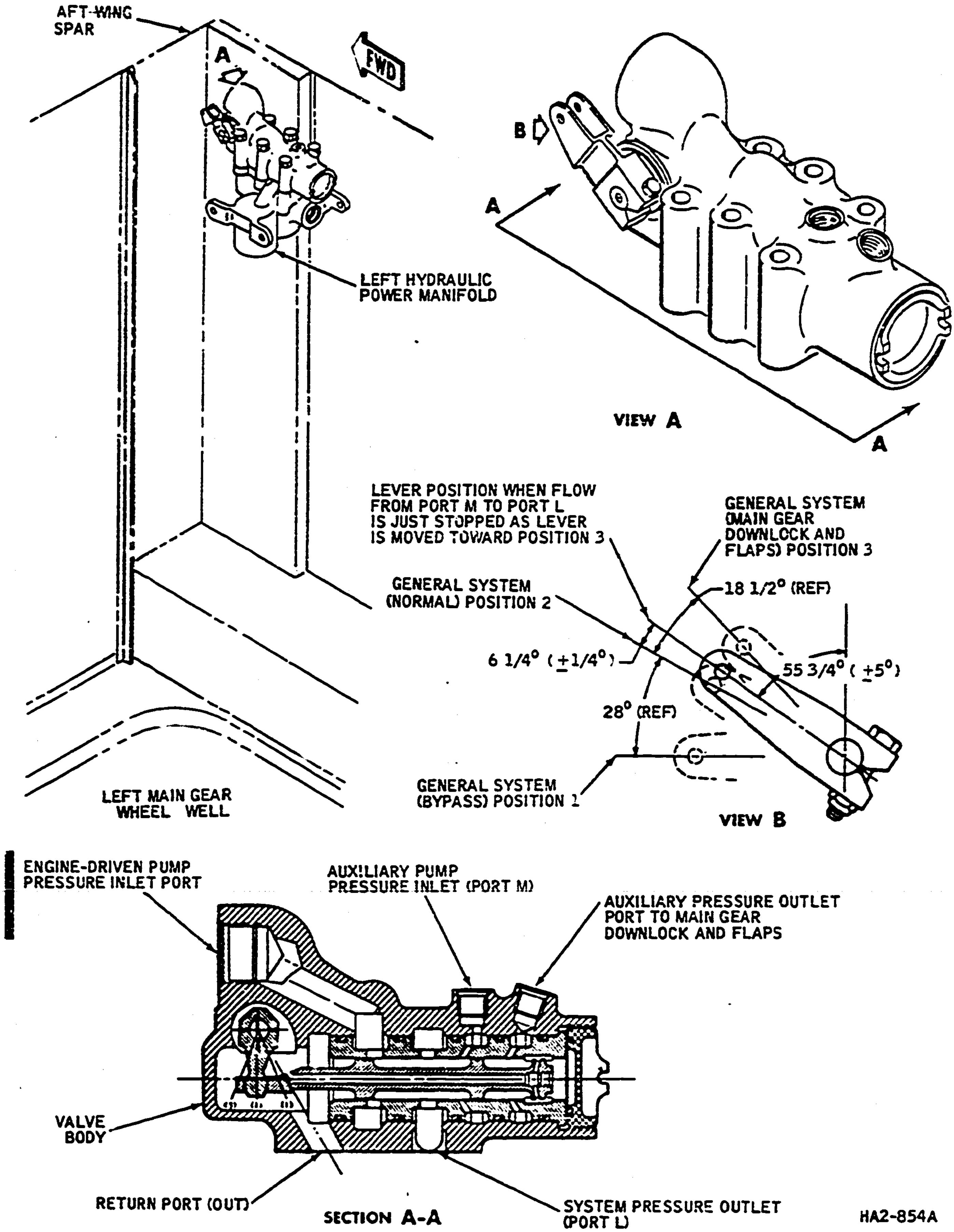
(2) On airplanes N8960T-N8962T, three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold



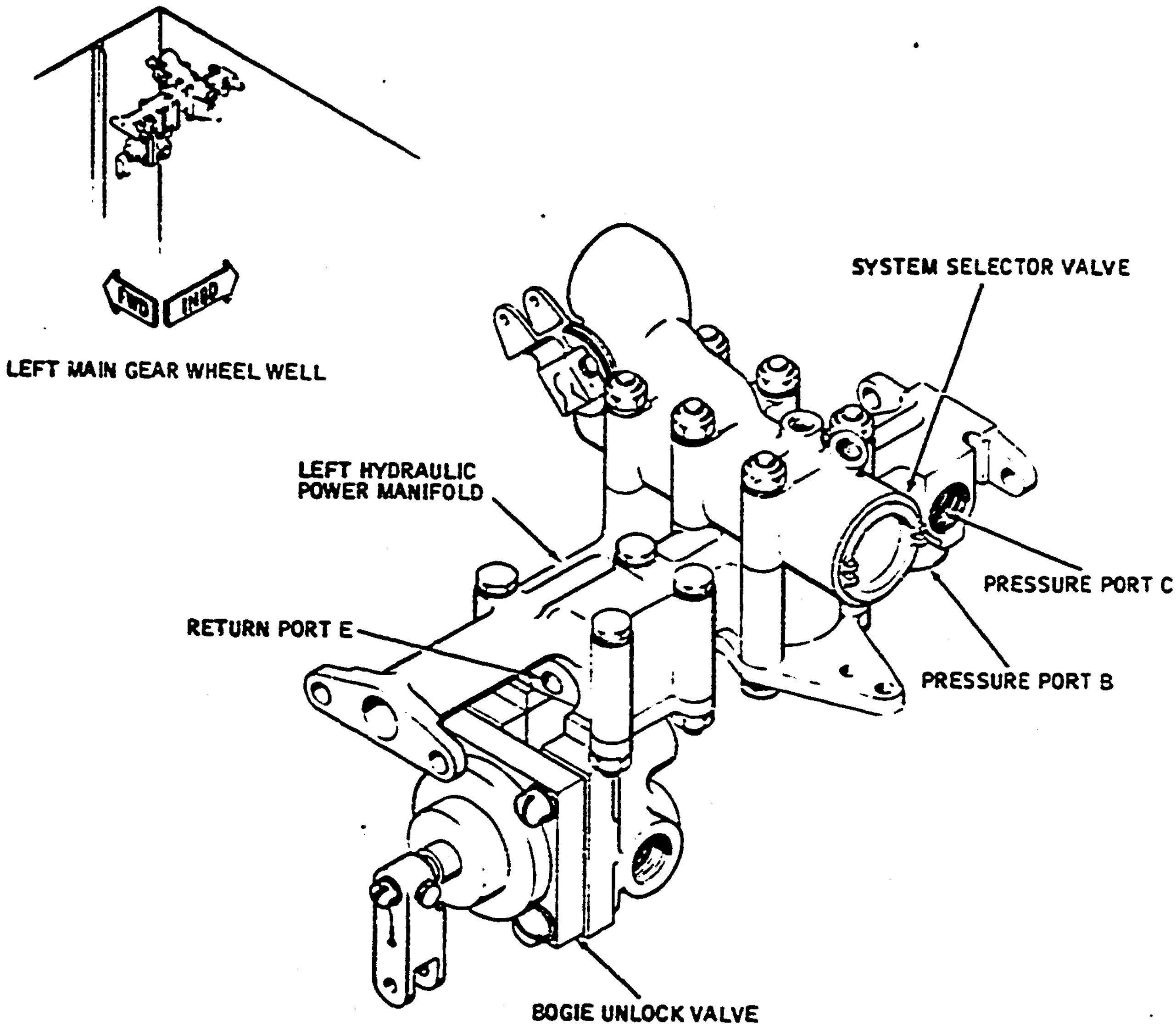
System Selector Valve -- Schematic
Figure 16

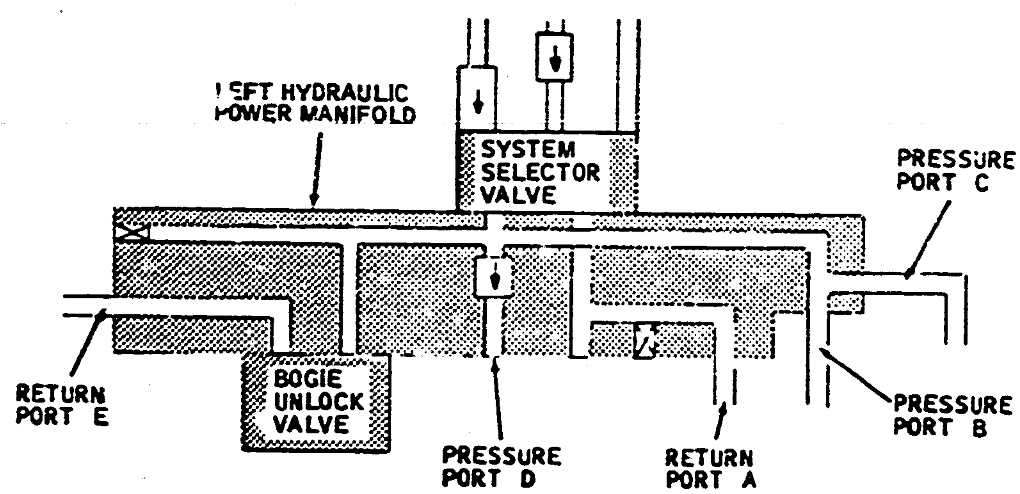


System Selector Valve -- Cutaway View
(Airplanes N8960T-N8962T)
Figure 17 (Sheet 1)



System Selector Valve -- Cutaway View
(Airplane N4863T and Subsequent)
Figure 17 (Sheet 2)





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Left Hydraulic Power Manifold -- Schematic
(Airplanes N8960T-N8962T)
Figure 18 (Sheet 1)

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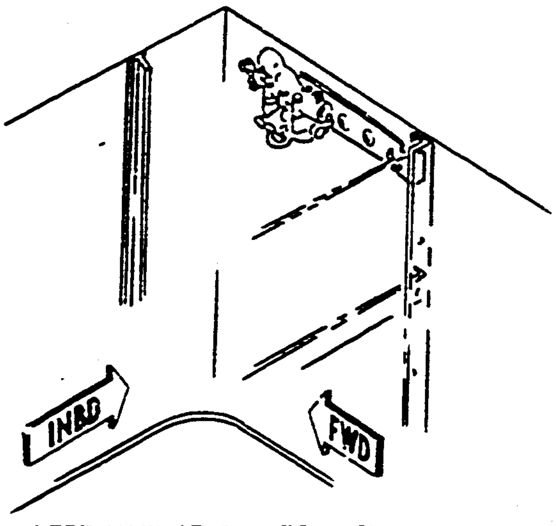
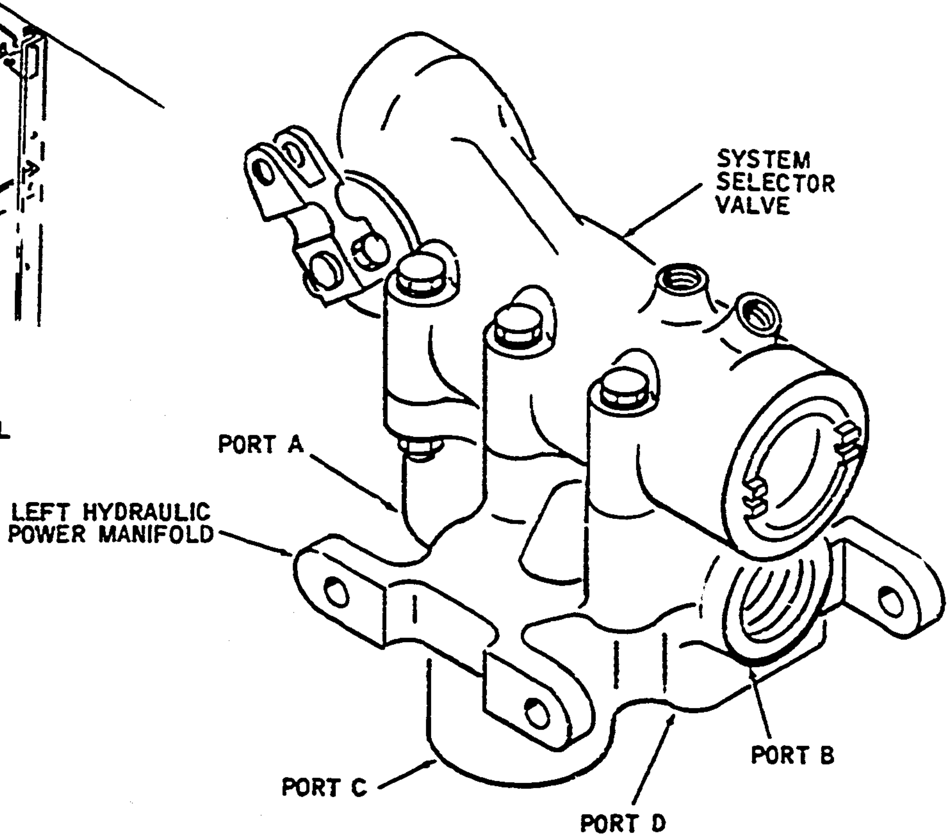
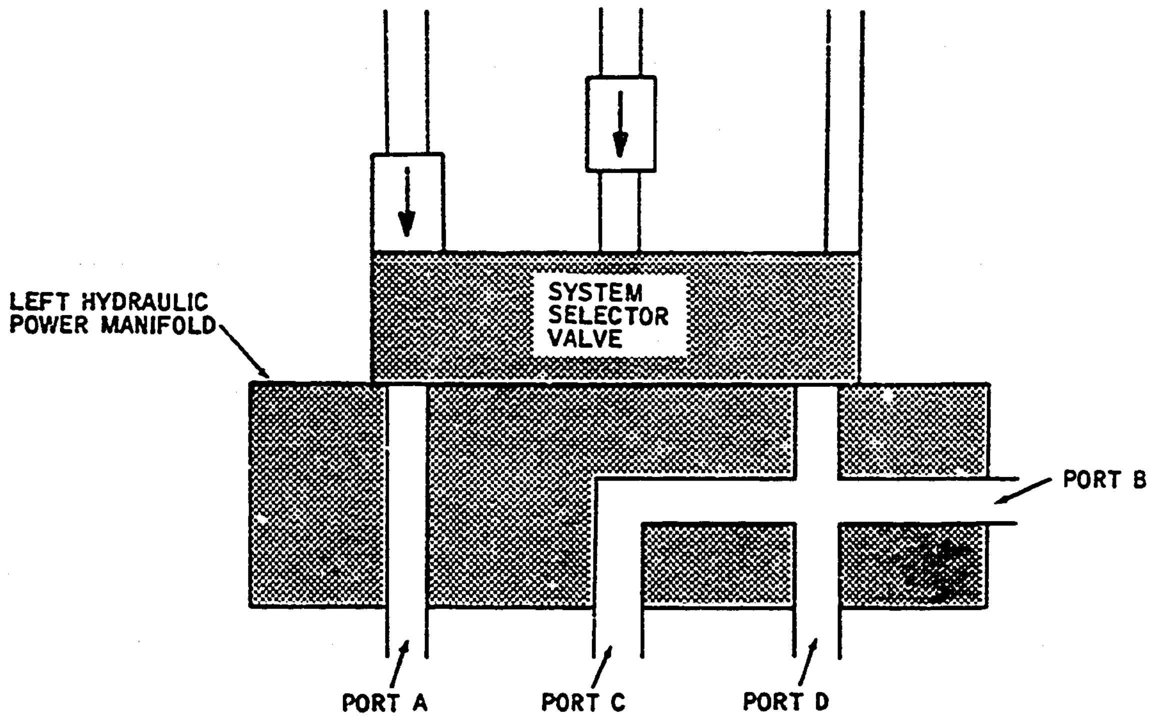






HA2-855

Left Hydraulic Power Manifold -- Schematic
(Airplane N4863T and Subsequent)
Figure 18 (Sheet 2)

pressure outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

(3) On airplanes N4863T and subsequent, one valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

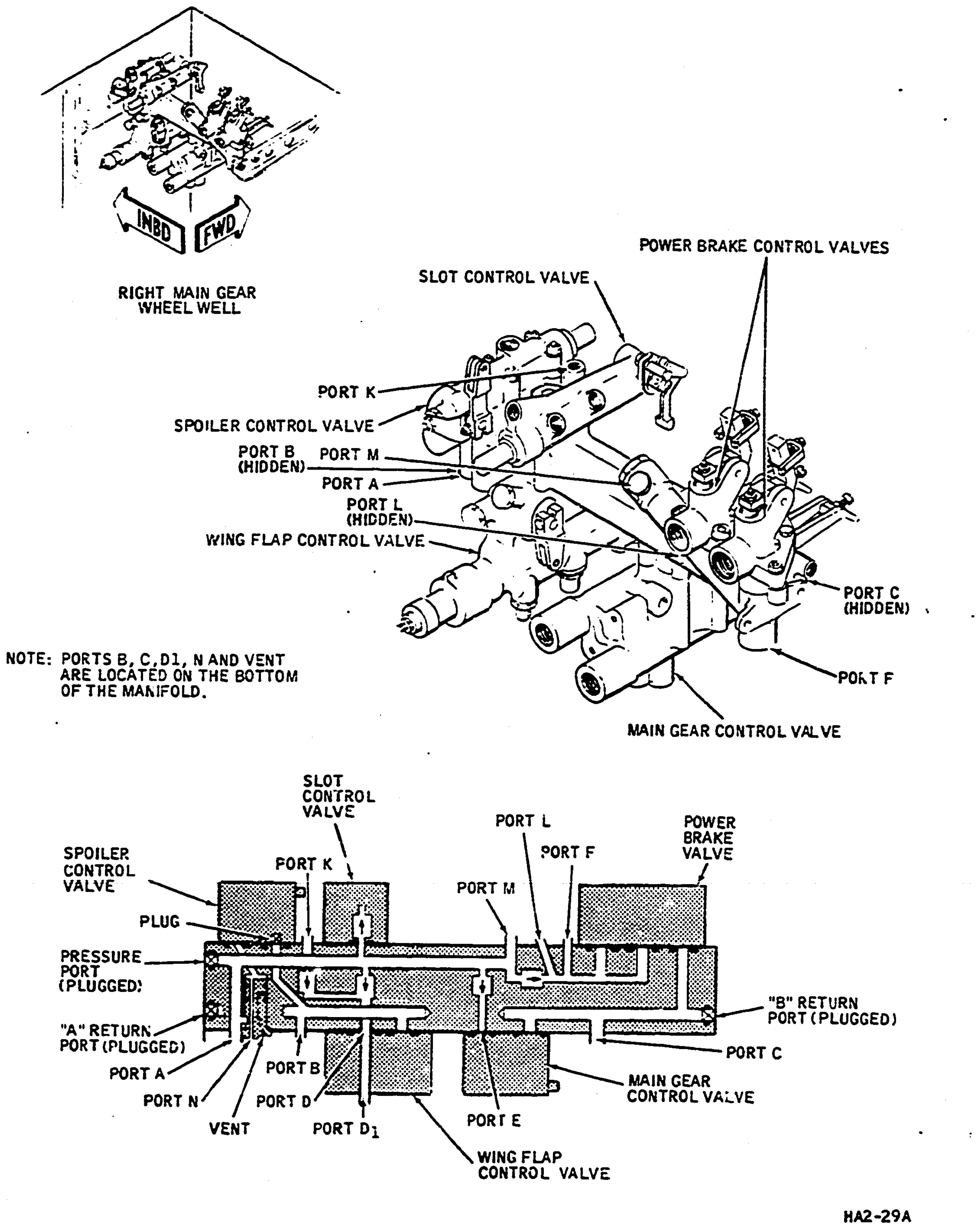
(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir.

The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Hydraulic Manifold Return Check Valves (Airplanes N8960T-N8962T See Figure 10.)

(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.



Right Hydraulic Power Manifold -- Schematic
Figure 19

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

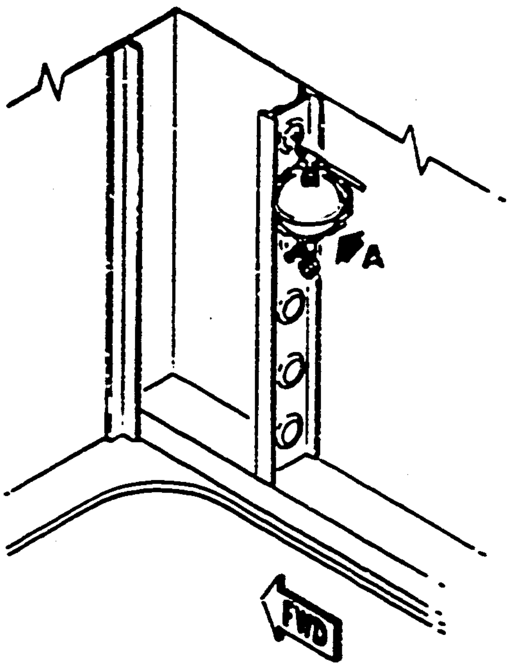
(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smoothes out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

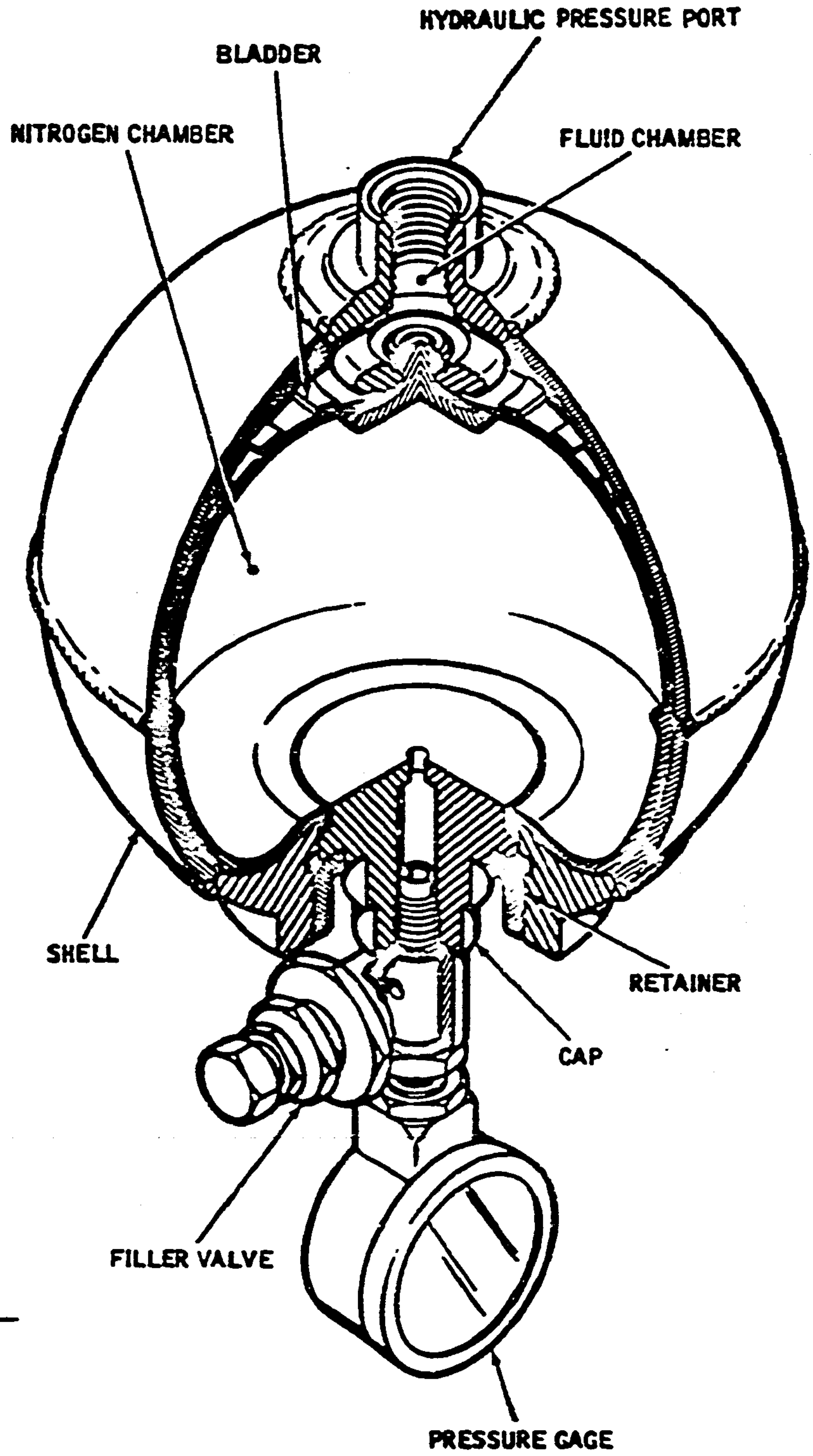
T. Hydraulic System Priority Valve (See Figure 21.)

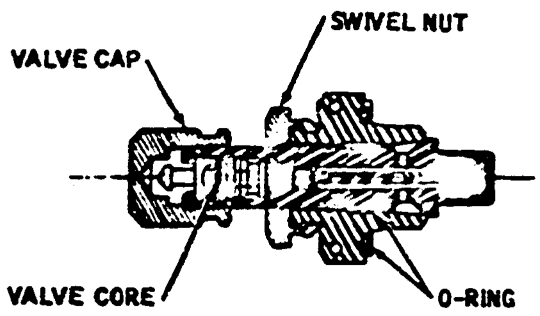
(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston a piston load-spring and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hold which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.



LEFT MAIN GEAR
WHEEL WELL



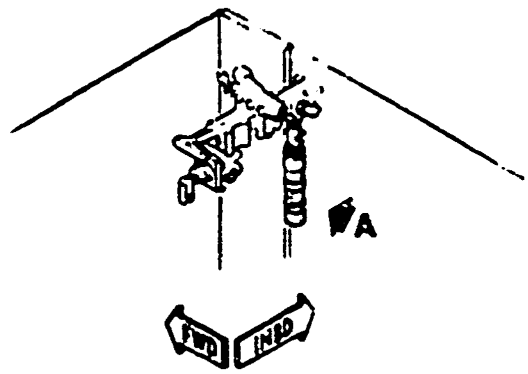


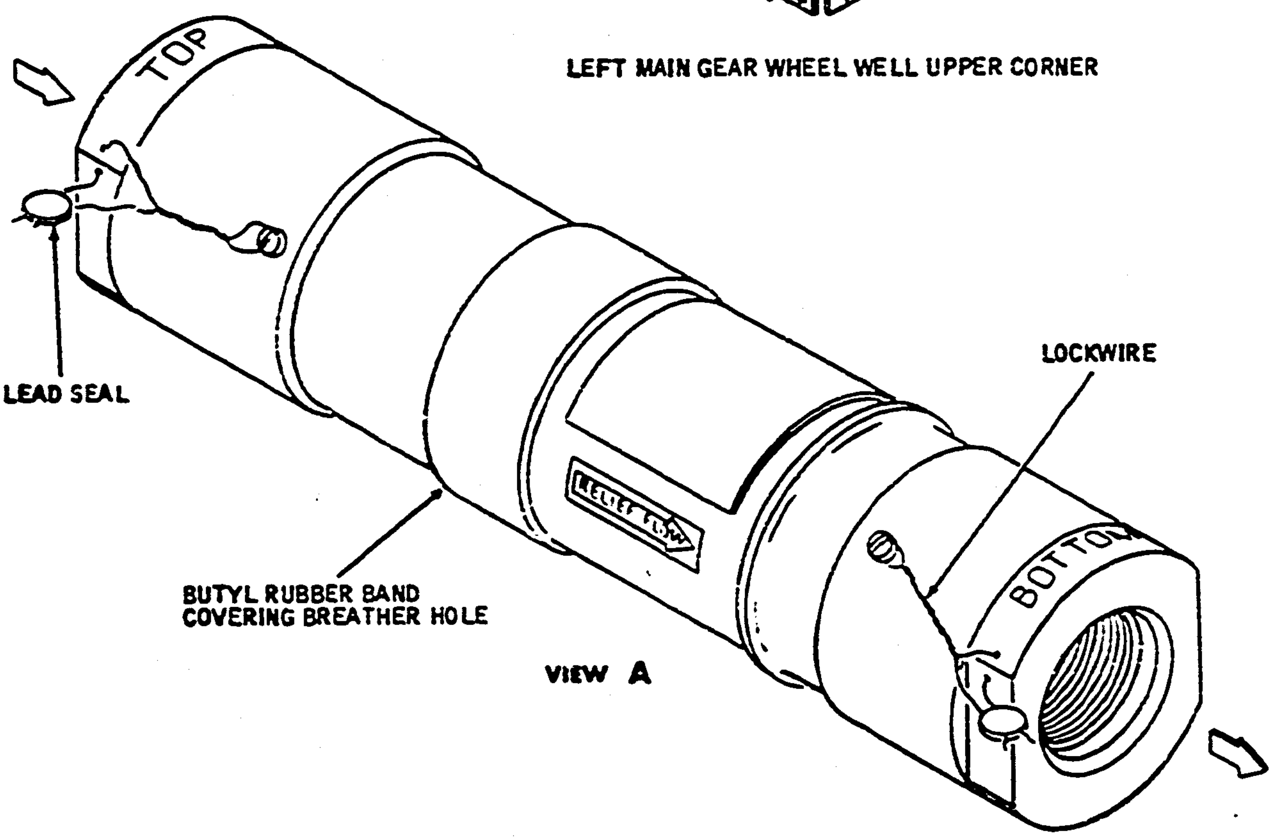
FILLER VALVE

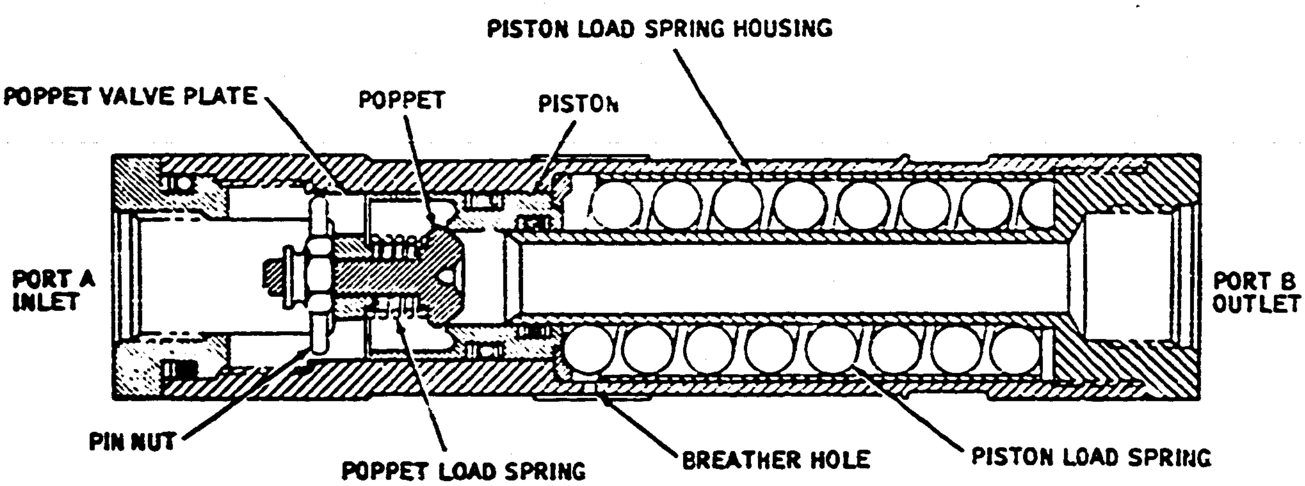
VIEW A

HA2-30

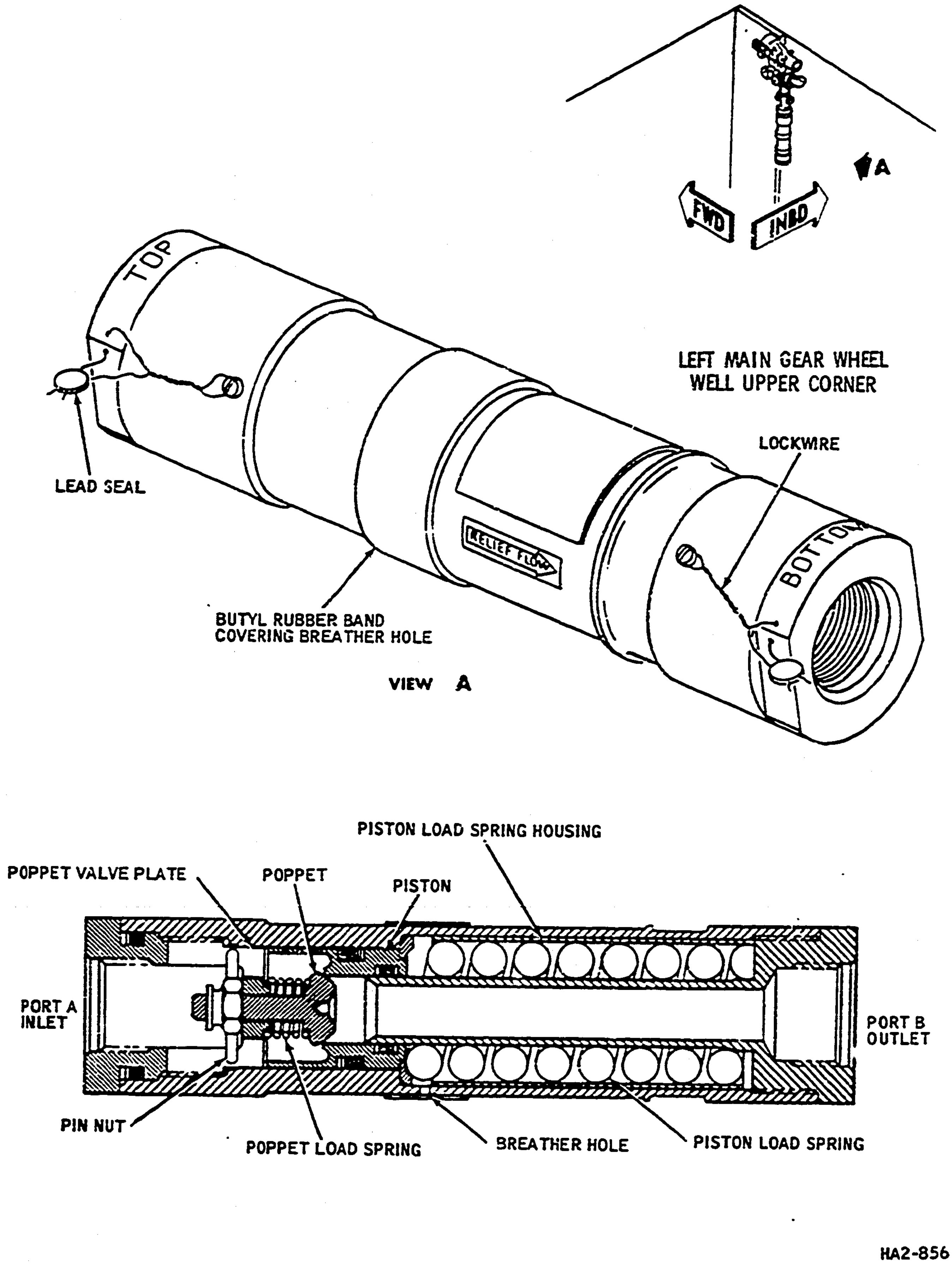
Hydraulic Power System Accumulator --
Cutaway View
Figure 20







Hydraulic System Priority Valve -- Cutaway View
(Airplanes N8960T-N8962T)
Figure 21 (Sheet 1)



Hydraulic System Priority Valve -- Cutaway View
(Airplane N4863T and Subsequent)
Figure 21 (Sheet 2)

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position.

At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

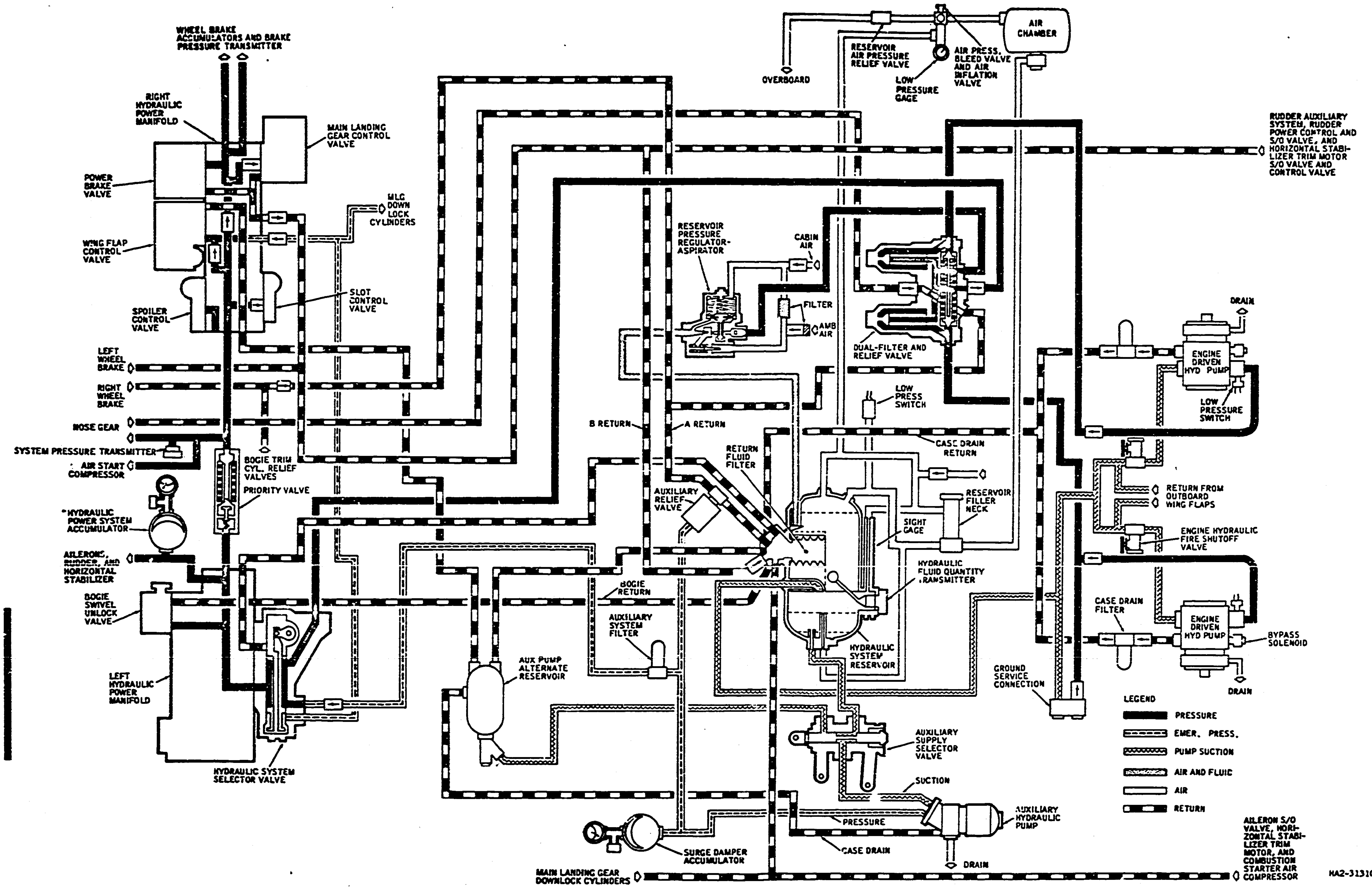
(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

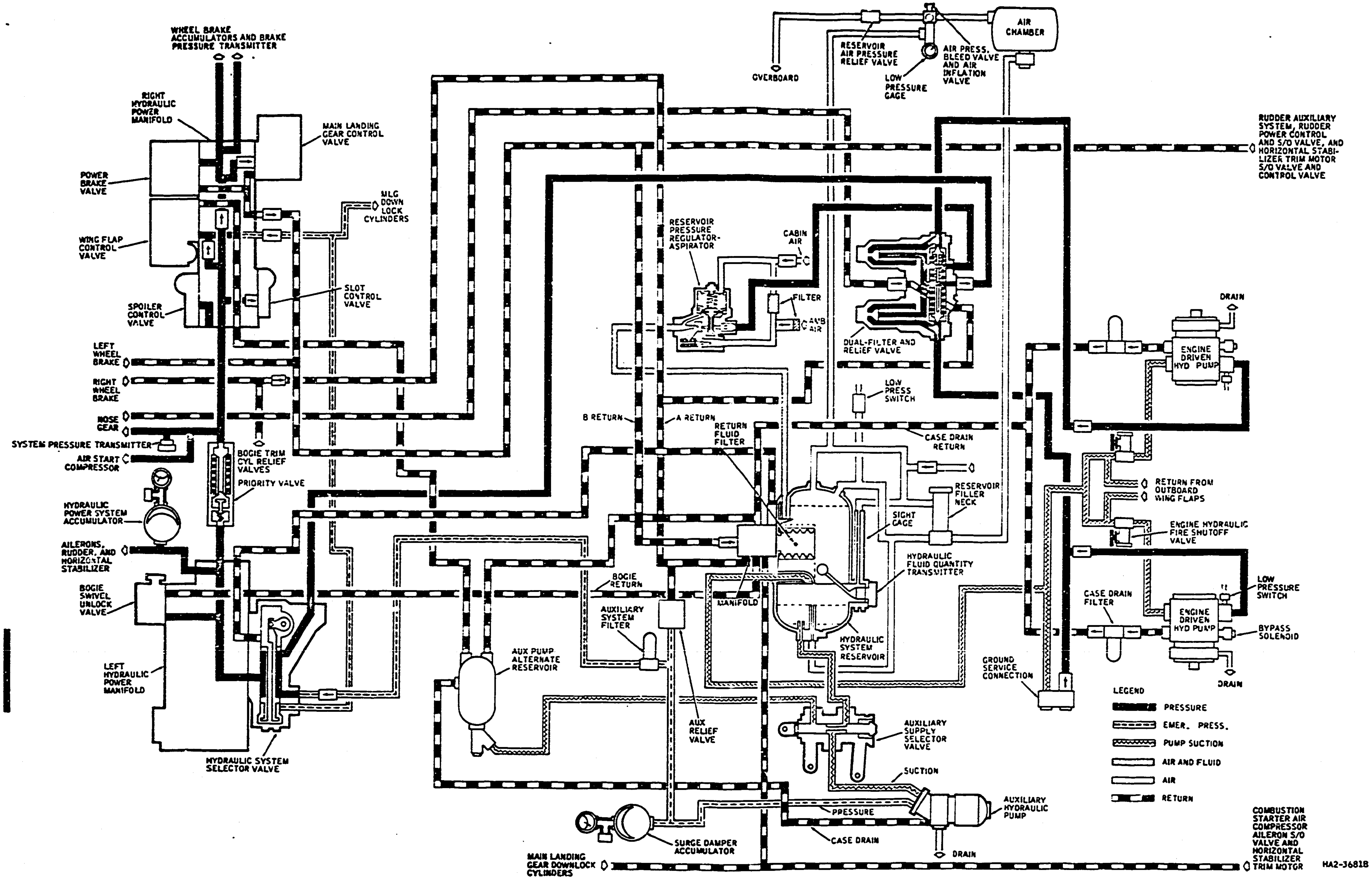
B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.



Hydraulic Power System -- Schematic Diagram
(Airplane N8786R)
Figure 1 (Sheet 1)



Hydraulic Power System -- Schematic Diagram
(Airplanes N8787R and Subsequent)
Figure 1 (Sheet 2)

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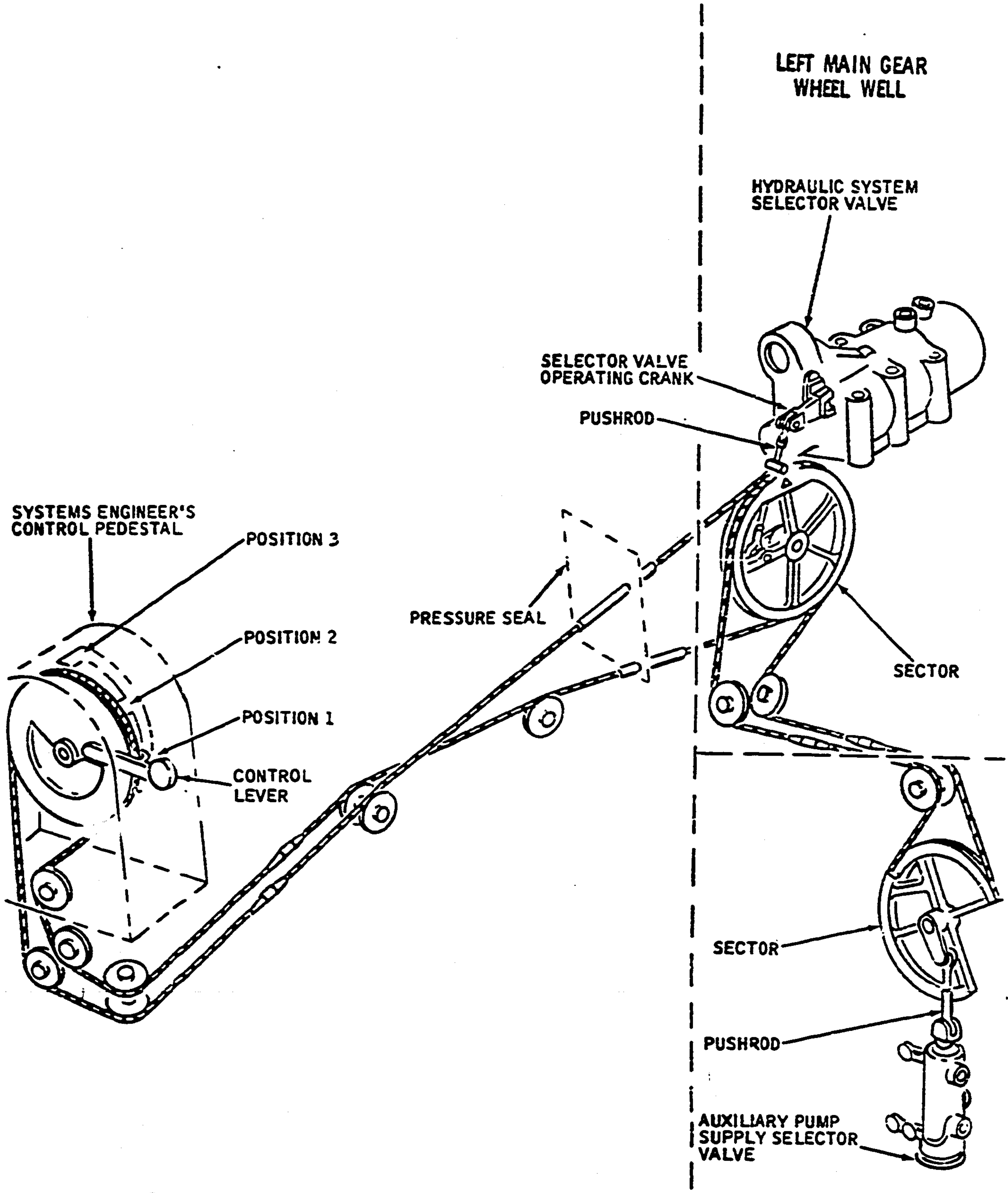


CONTROL POSITIONS

1. BYPASS/GENERAL SYSTEM
2. GENERAL SYSTEM (NORMAL)
3. GENERAL SYSTEM/MAIN GEAR DOWN AND FLAPS

HA2-486

Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff.

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake.

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from slot control valve is ported into the A return line to the main

reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

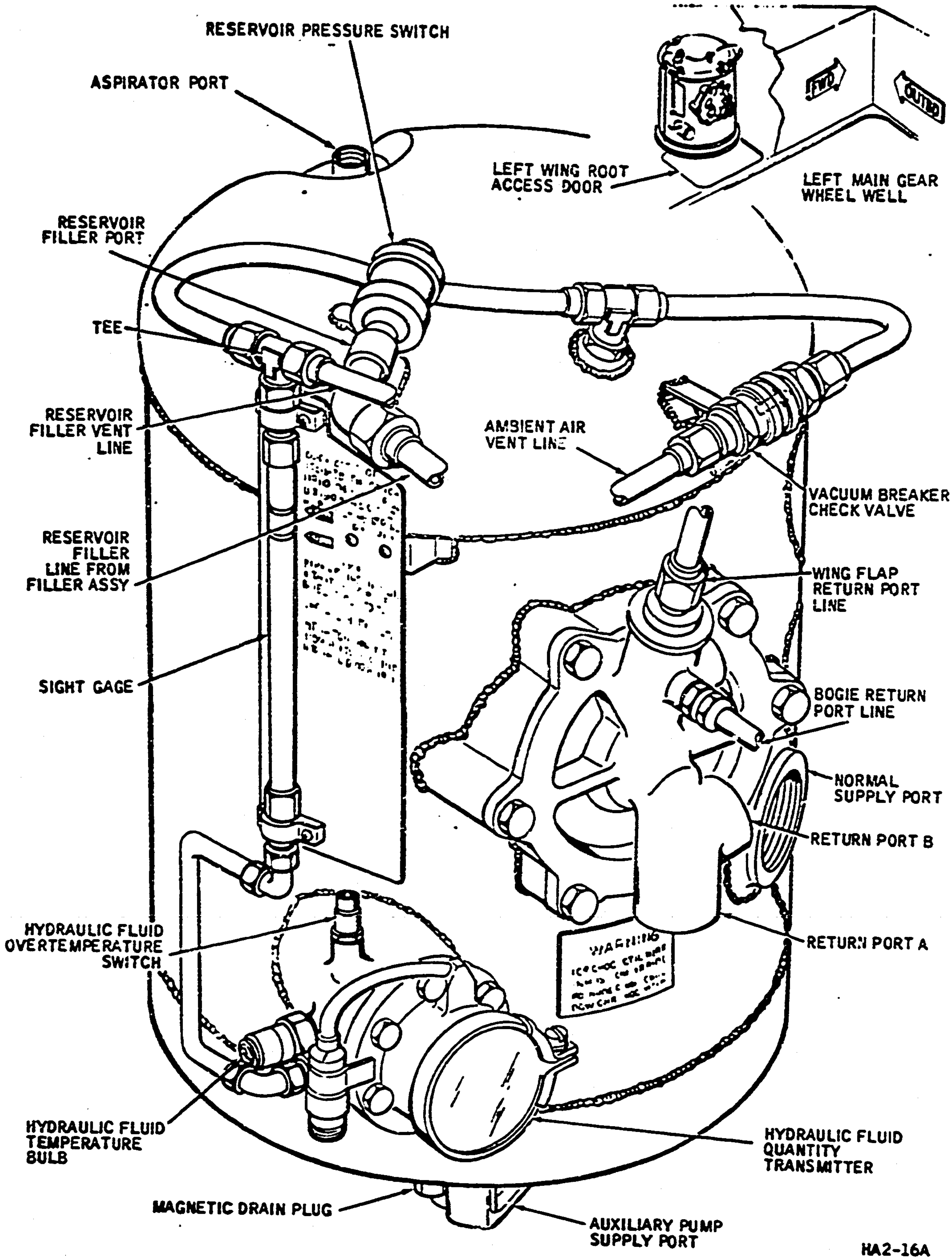
(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) On airplane N8786R the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The manifold is bolted to the flange and contains five ports: return port A, located at the bottom; return port B, located at the lower right side; the low-pressure return port, located at the upper right; the wing flap return port, located at the top; and the bogie return port, located on the face of the manifold just below the wing flap return port.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the manifold holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) On airplanes N8787R and subsequent, the mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange



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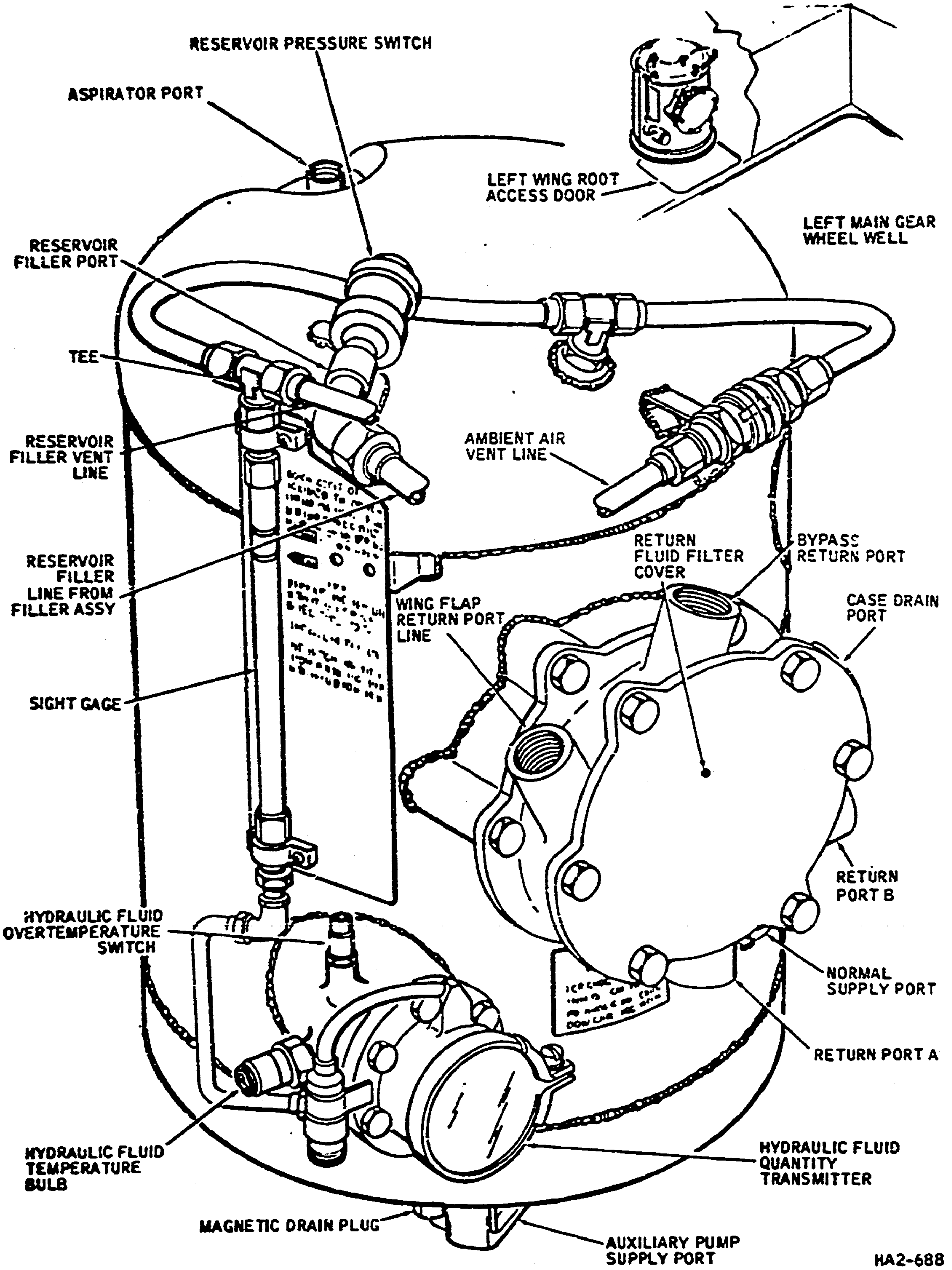
Hydraulic System Reservoir -- External View
(Airplane N8786R)
Figure 3 (Sheet 1)



Hydraulic System Reservoir -- External View
(Airplanes N8787R and Subsequent)
Figure 3 (Sheet 2)

on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(7) The return fluid filter is installed in the reservoir behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

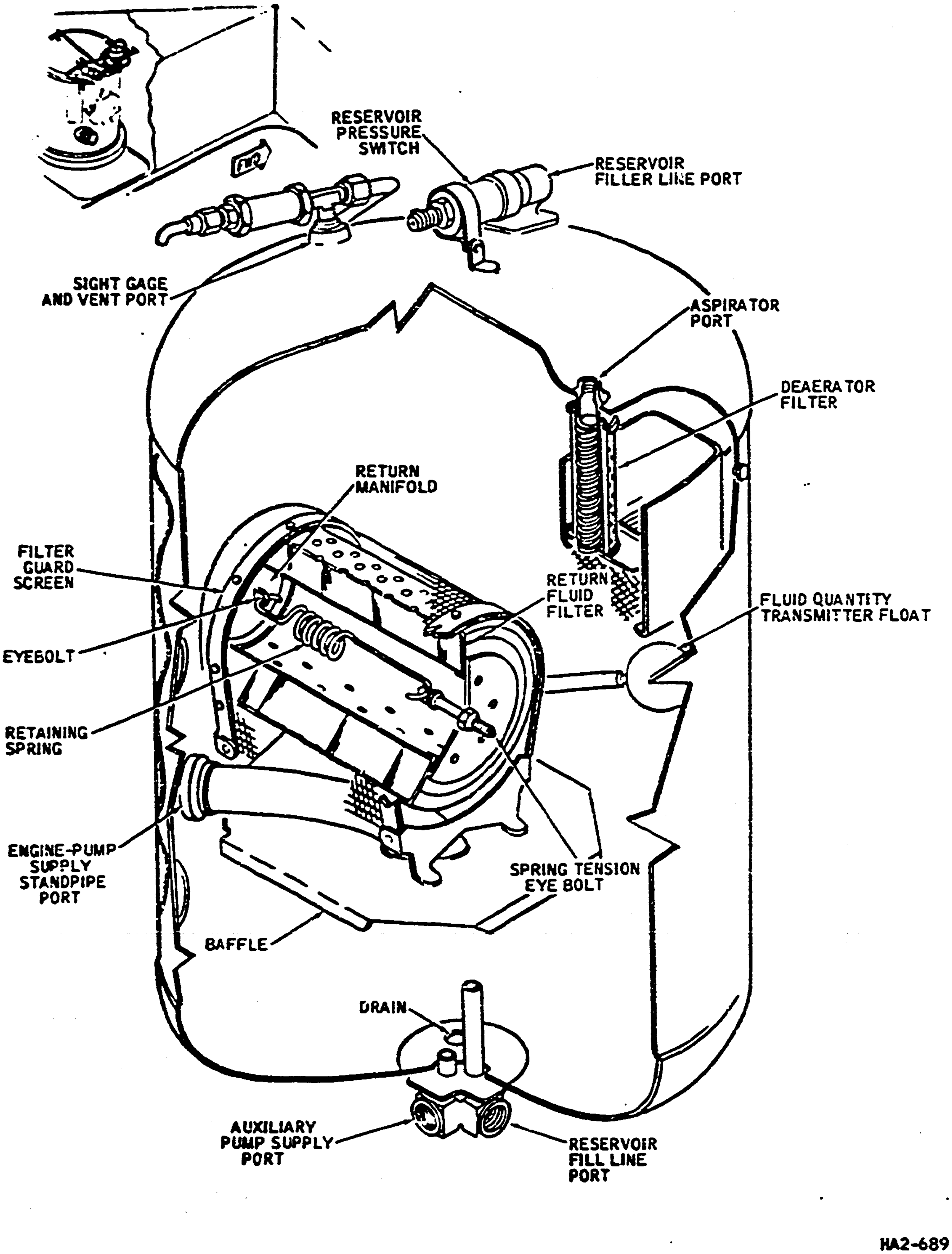
(8) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold and is spring loaded to act as its own relief valve. On airplane N8786R access to the filter is by removing the return ports manifold. Removal of the return ports manifold necessitates disconnecting the return lines from the manifold and removal of six bolts which secure the manifold to the reservoir. The filter which is attached to the manifold is then withdrawn from the reservoir. On airplanes N8787R and subsequent access to the filter is gained by removing the return filter cover from the return ports manifold by removal of six bolts. The filter is attached to the cover by a retaining spring, and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold. The spring passes through the center



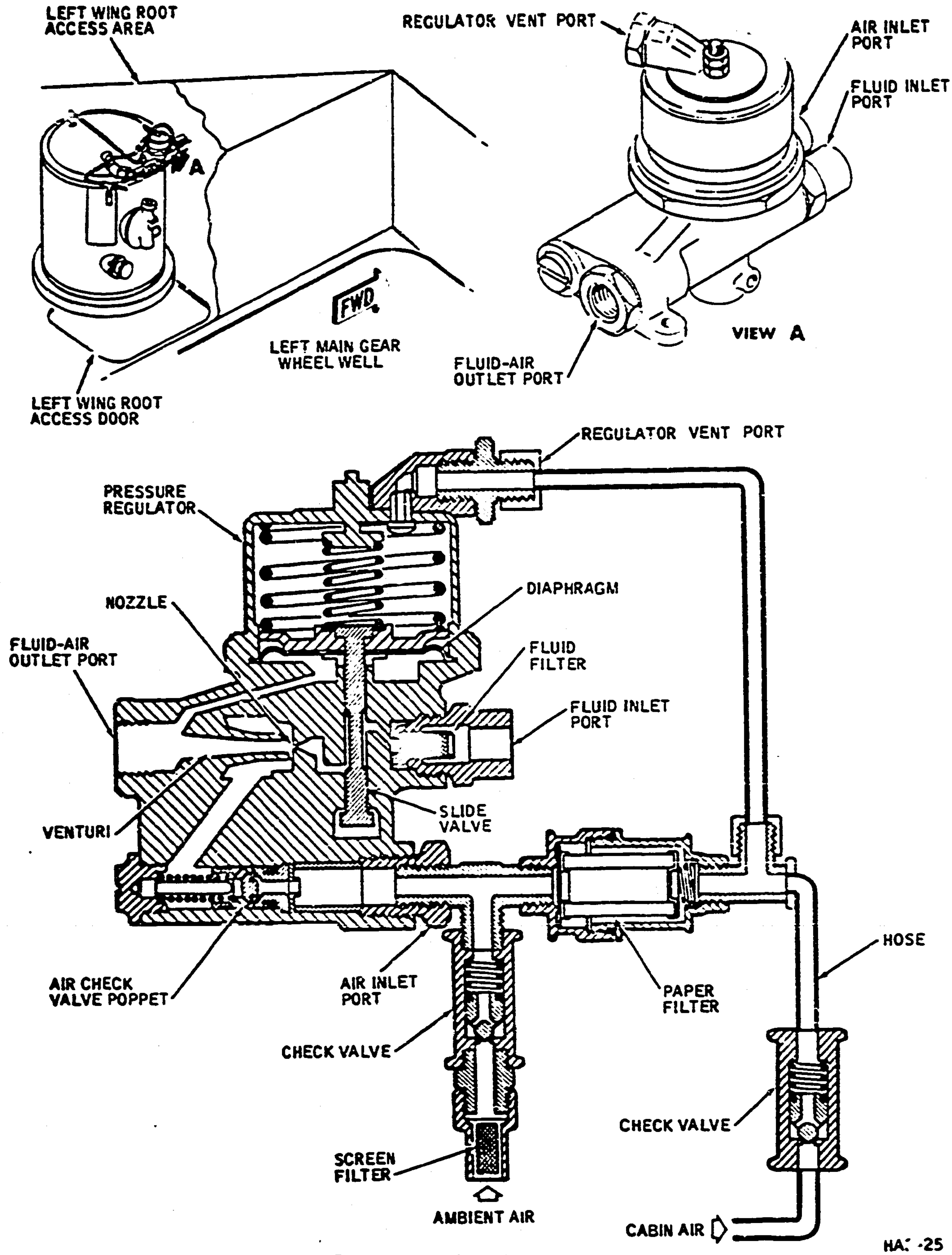
Hydraulic System Reservoir -- Cutaway View
Figure 4

chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.



Reservoir Air Pressure
Regulator-Aspirator -- Schematic
Figure 5

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

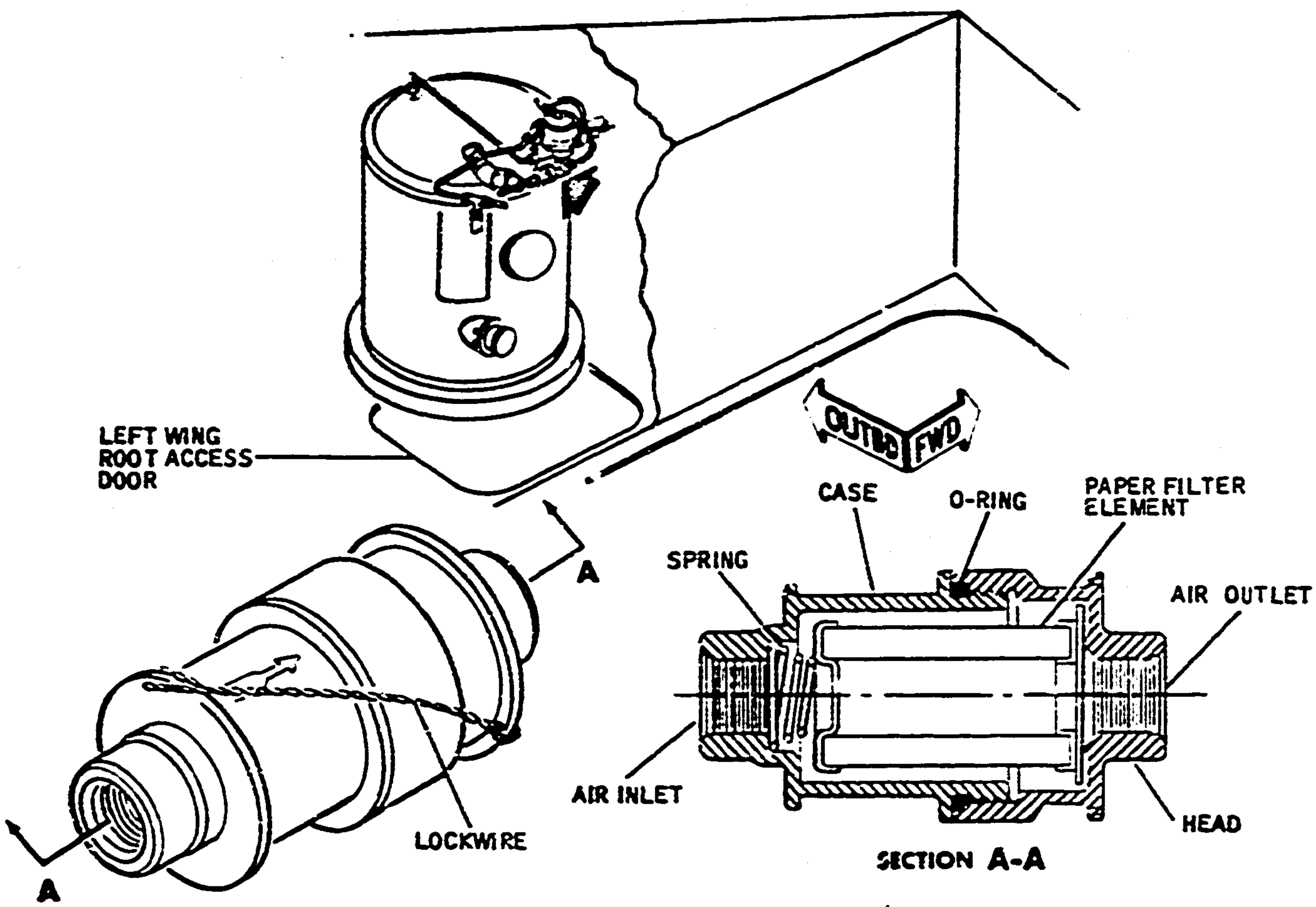
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

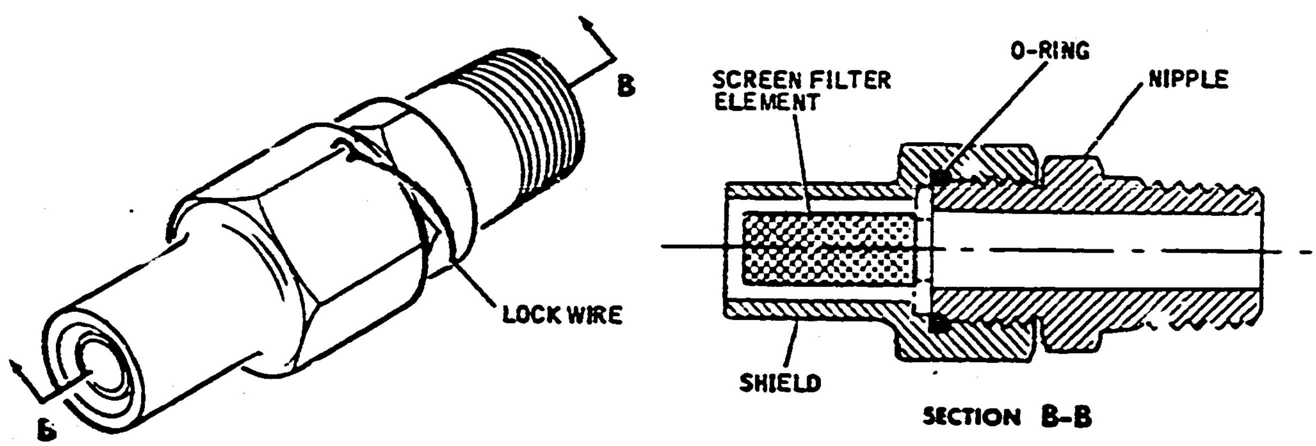
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.



PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters --
Cutaway View
Figure 6

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

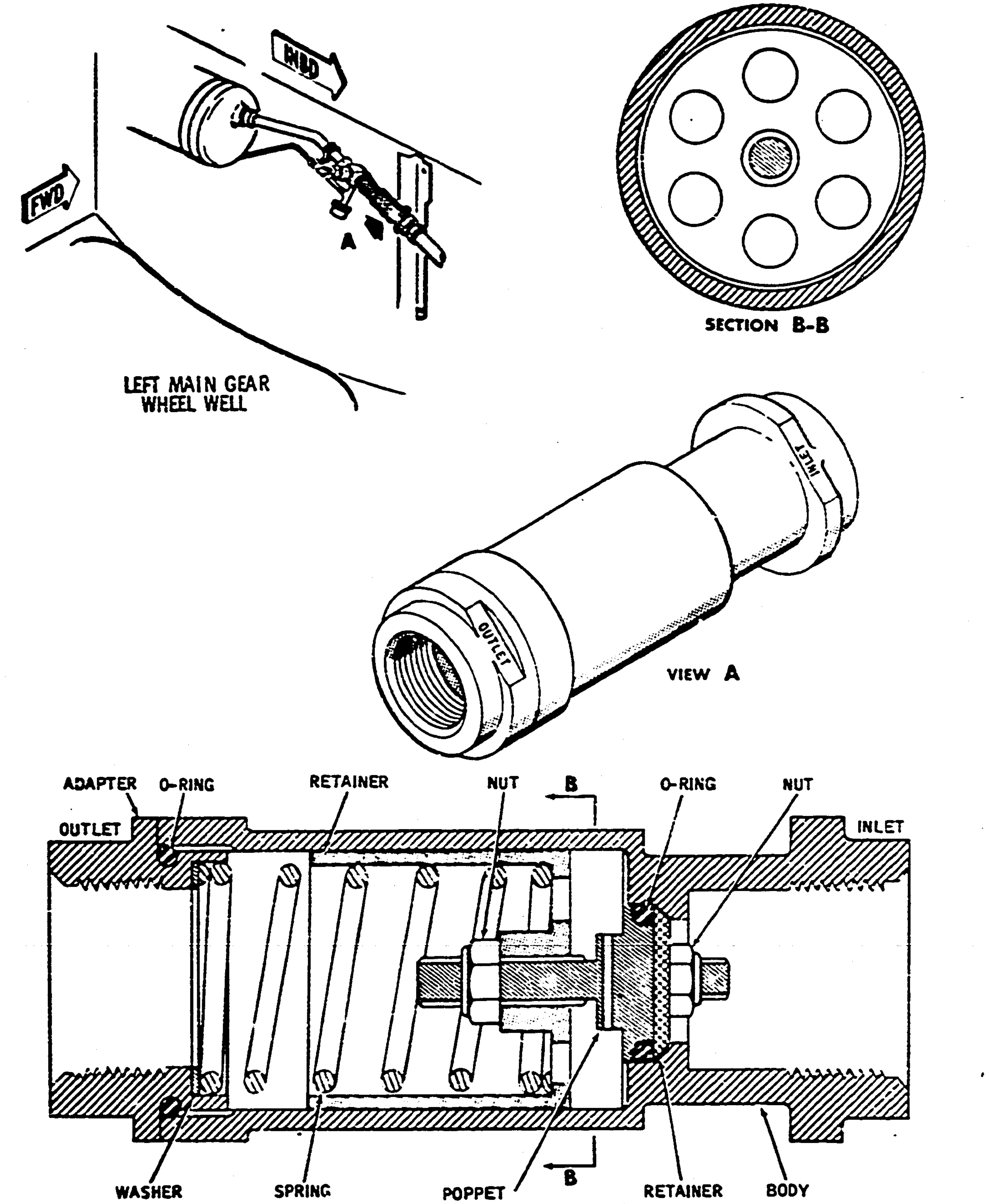
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is



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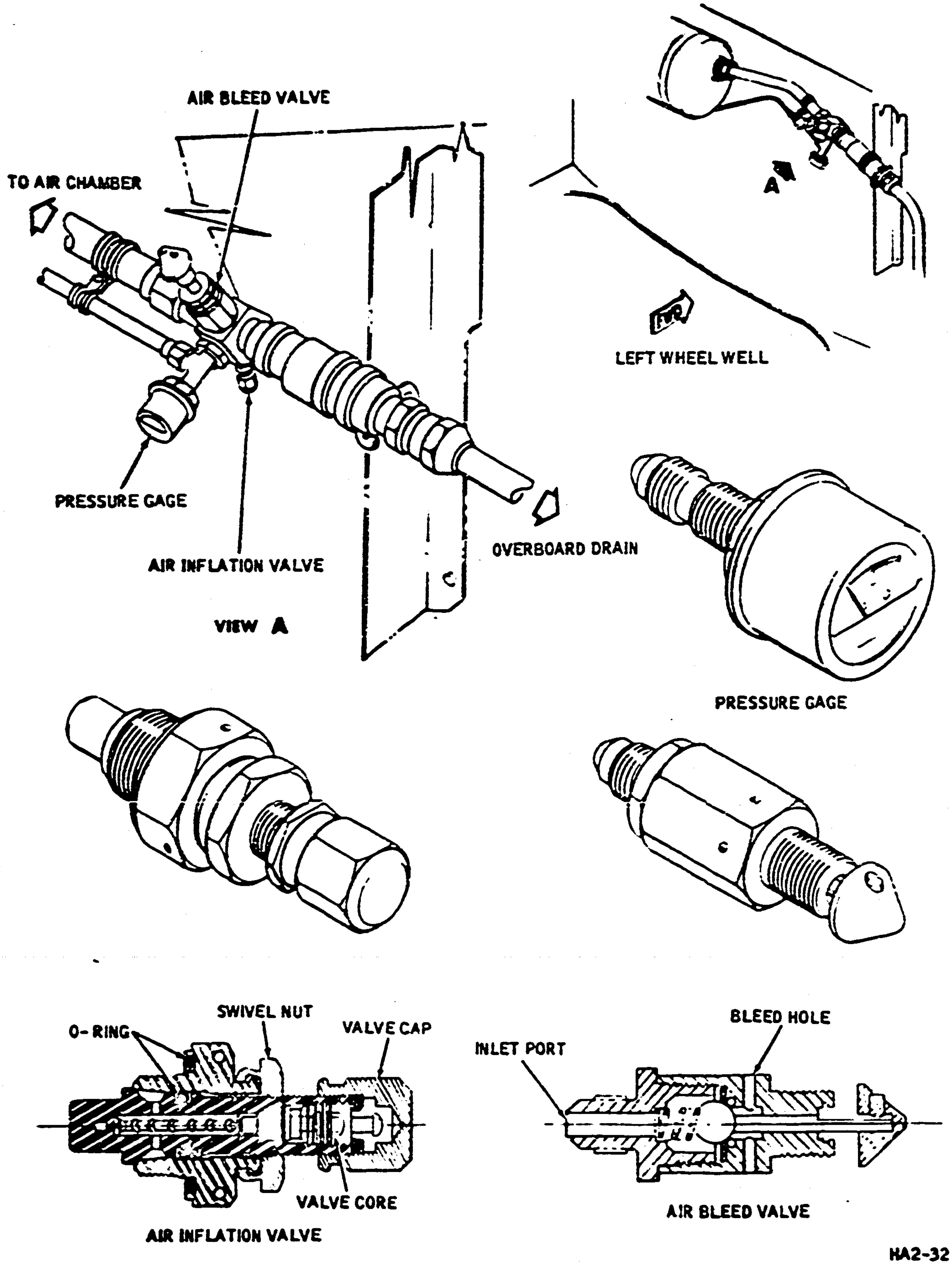
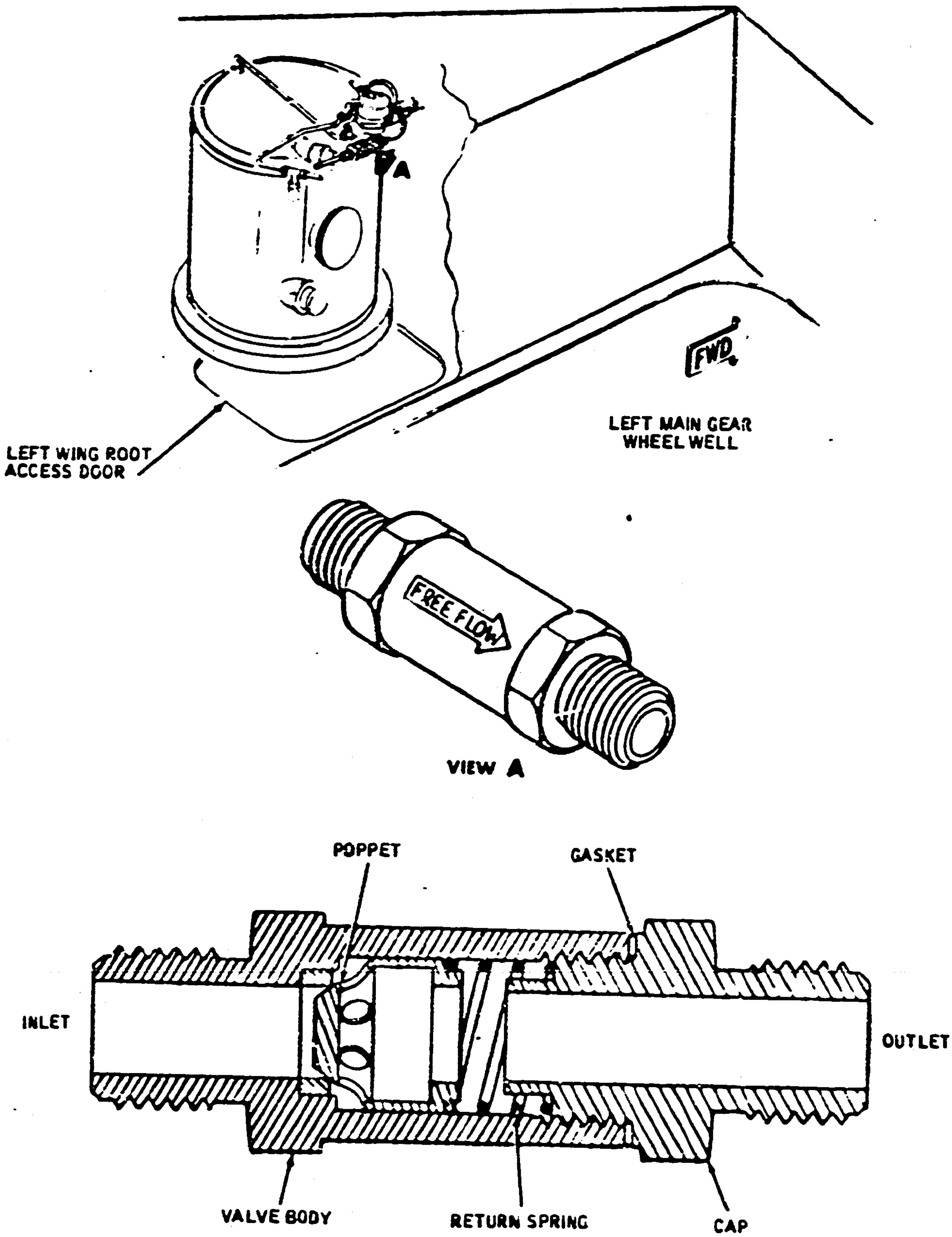
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



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Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

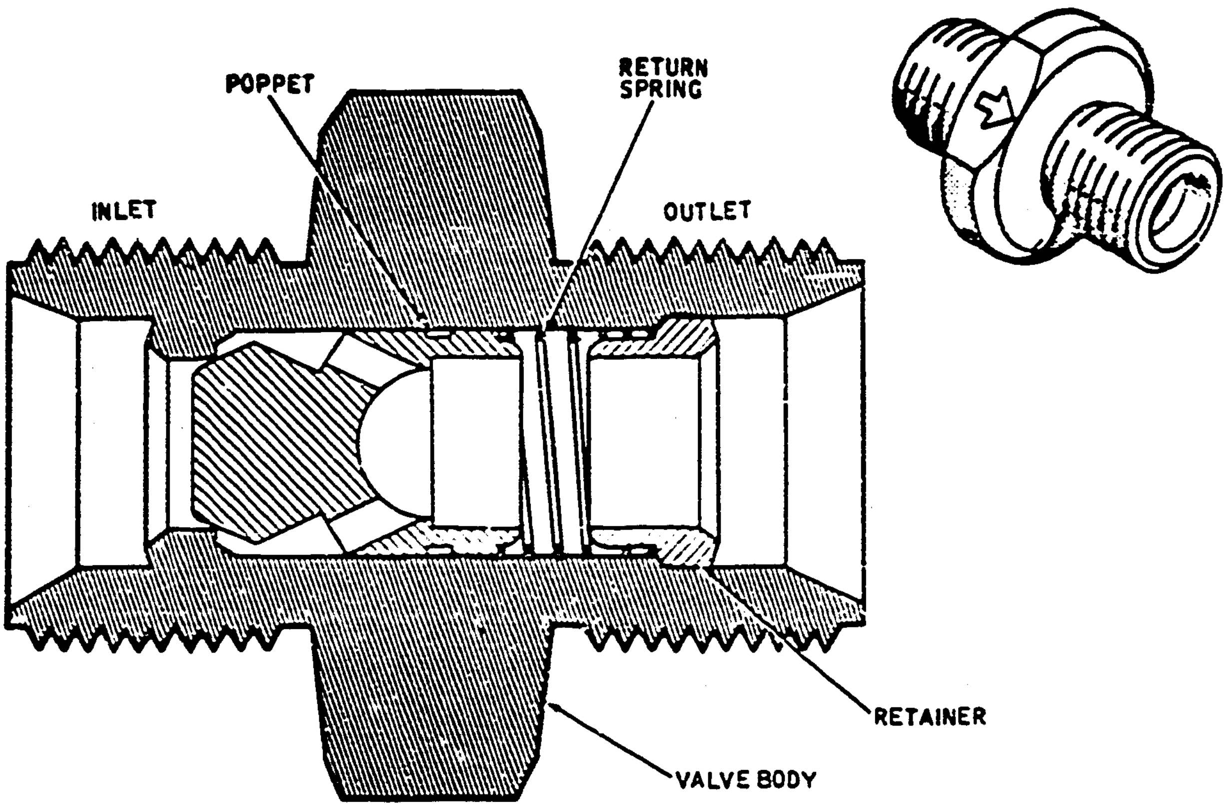
(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

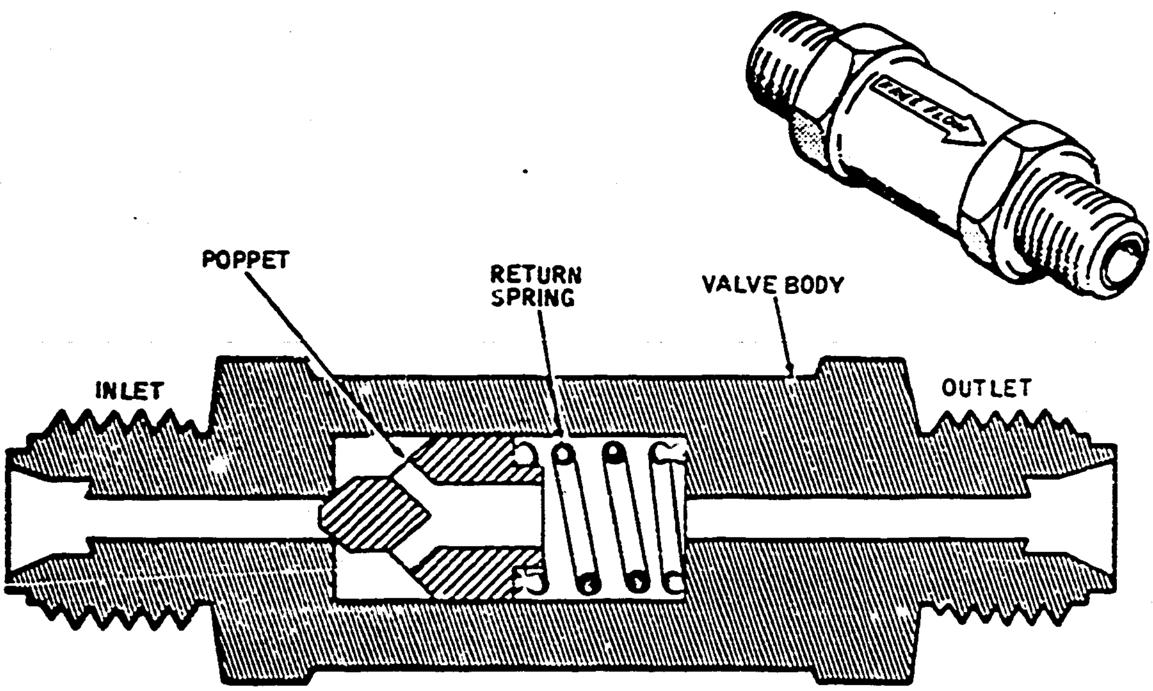
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is acutated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.



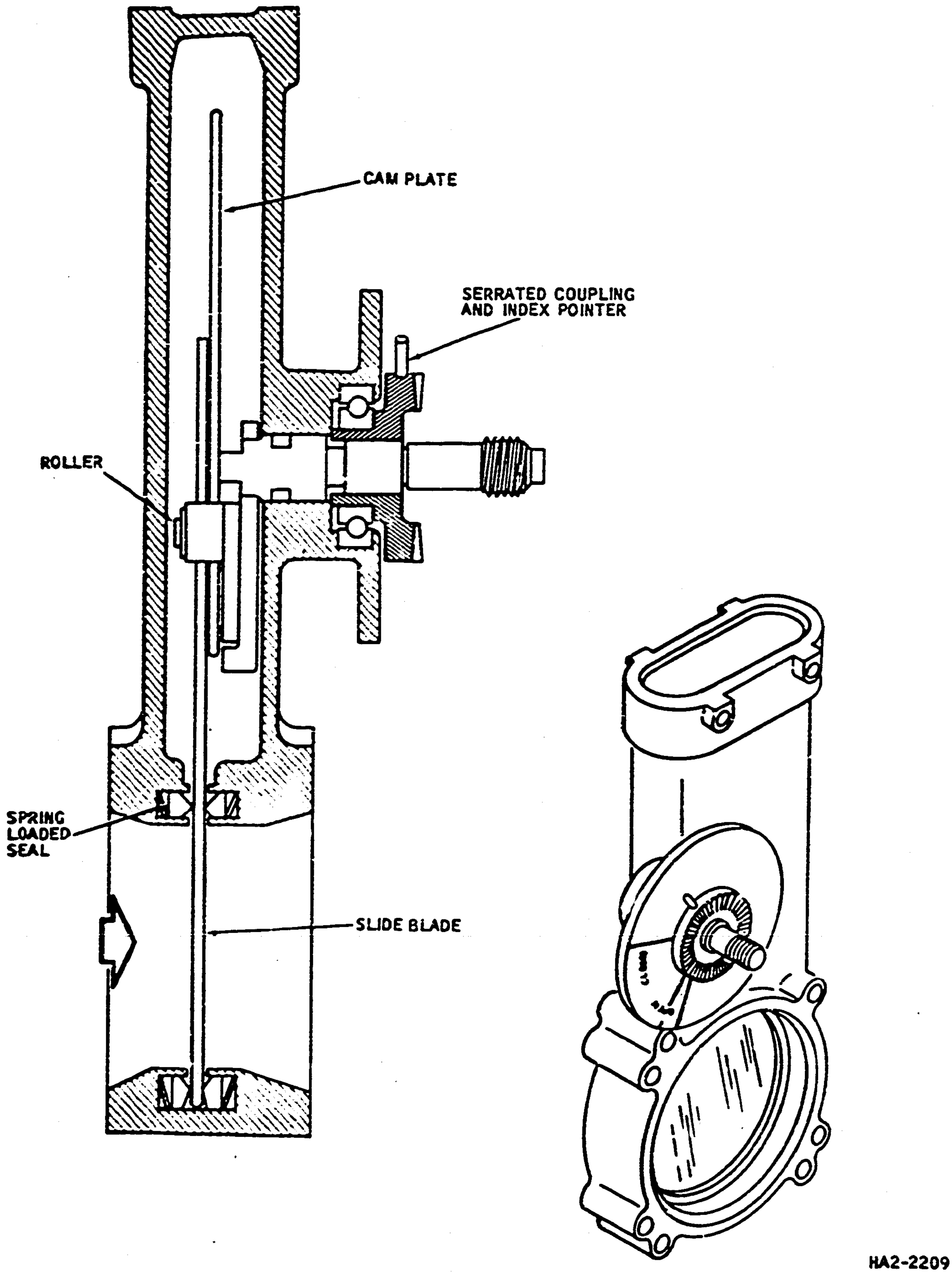
MINIATURE CHECK VALVE



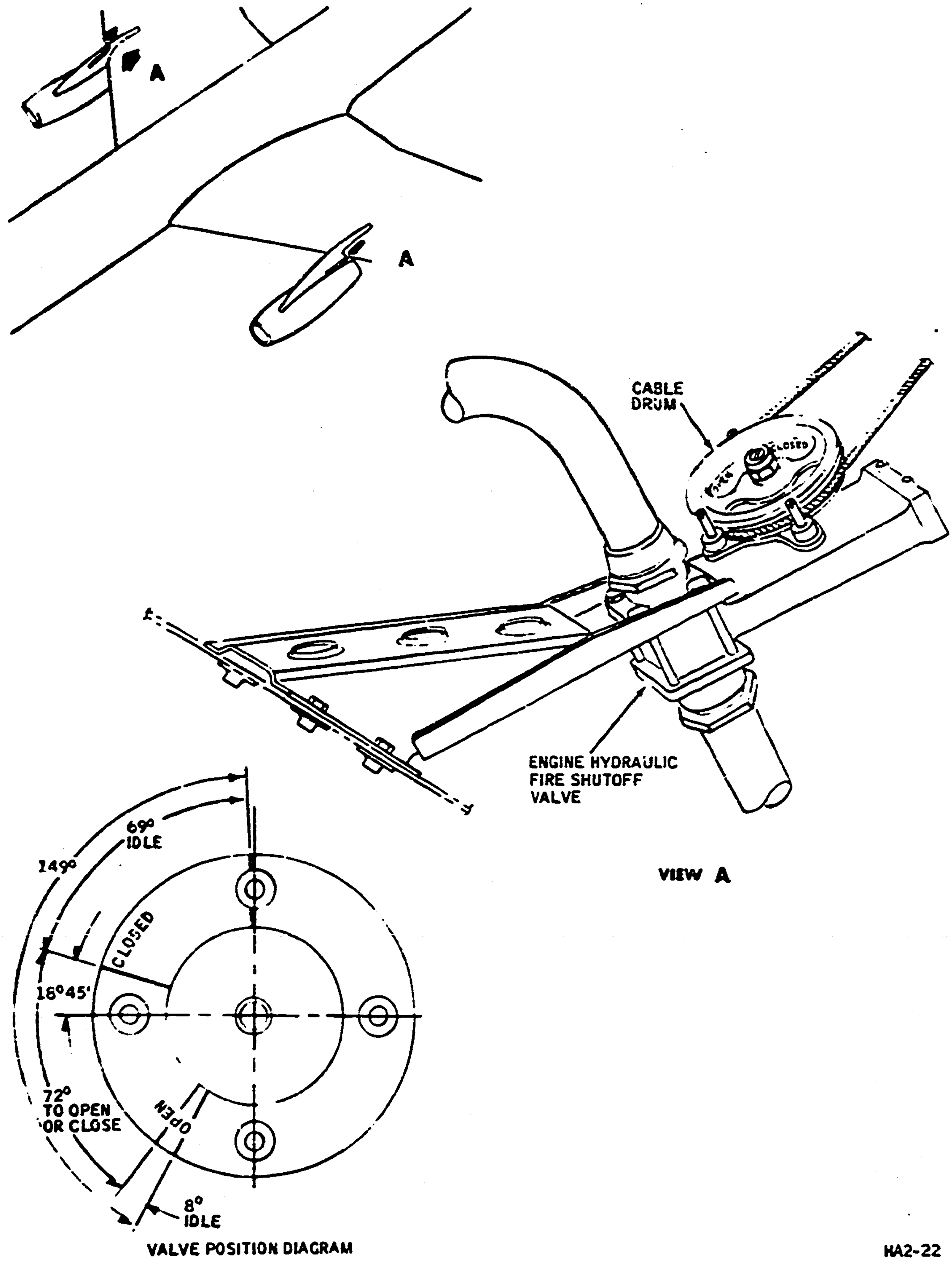
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

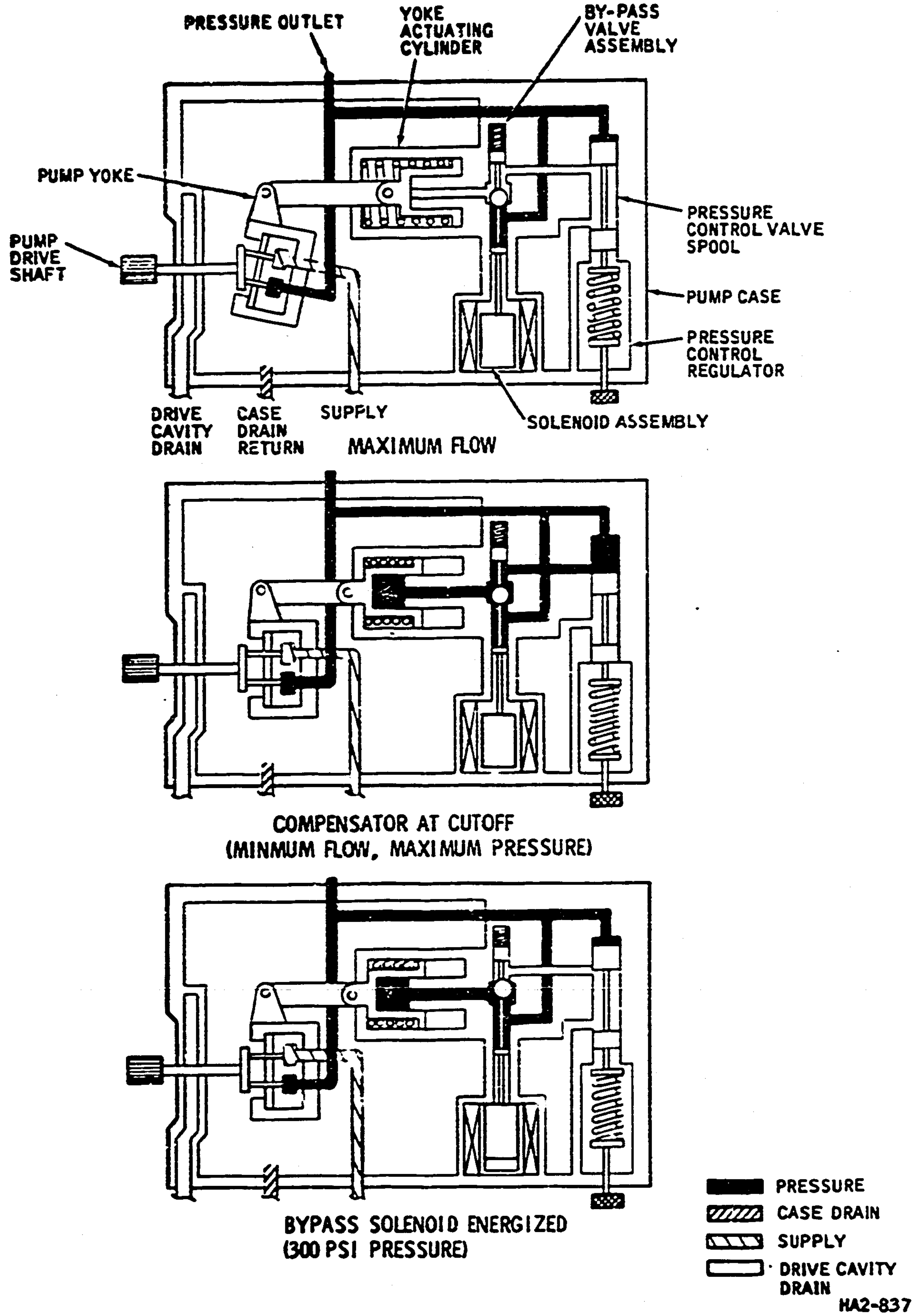
(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handles for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure. to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low-pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. If the engine-driven hydraulic pump control switches are in the on position, and the output pressure of either pump drops below 1500 psi, an amber light located in the flight compartment comes on.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

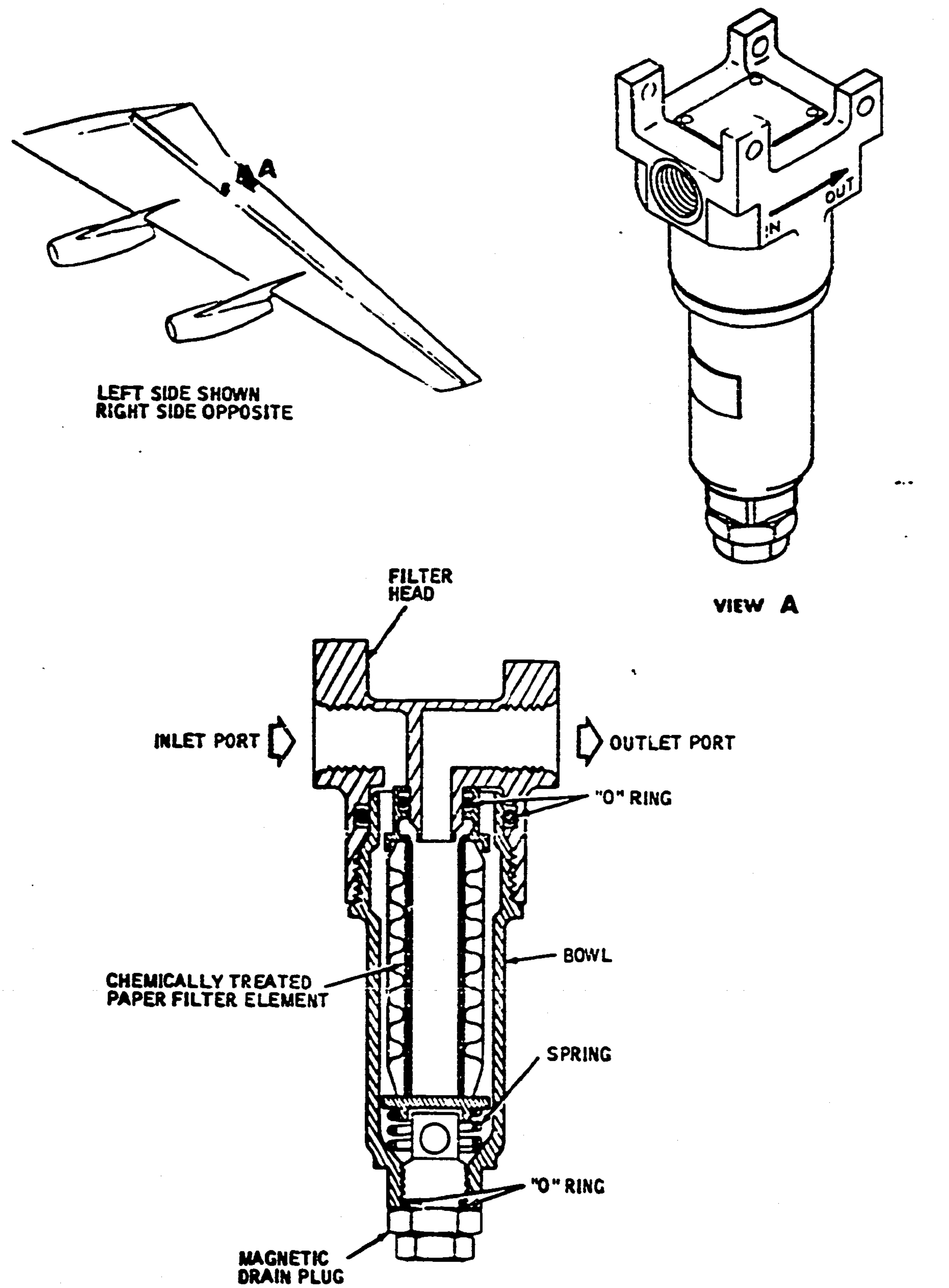
(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

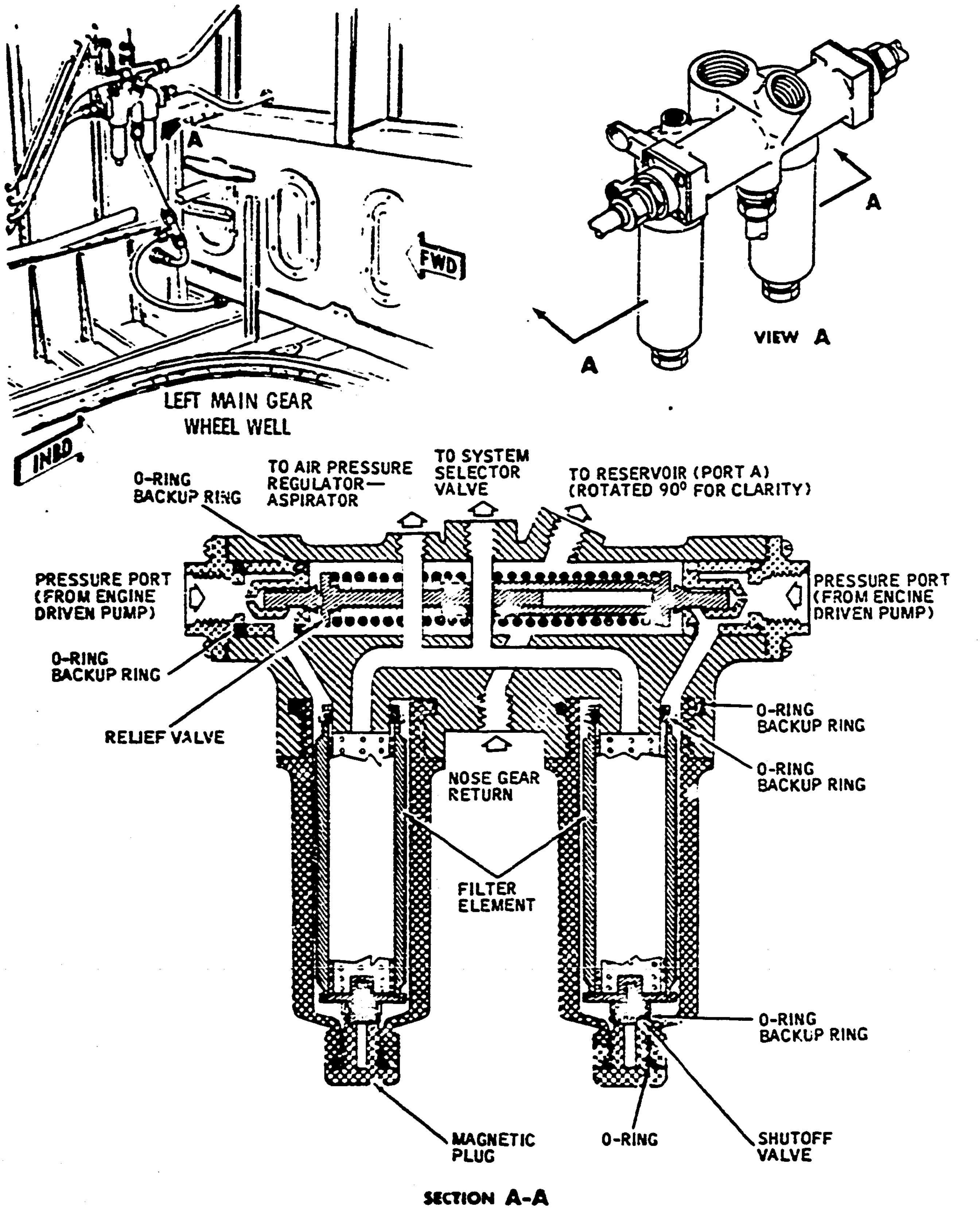
(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.



HA2-31

Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



Dual Filter and Relief Valve -- Cutaway View
Figure 15

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

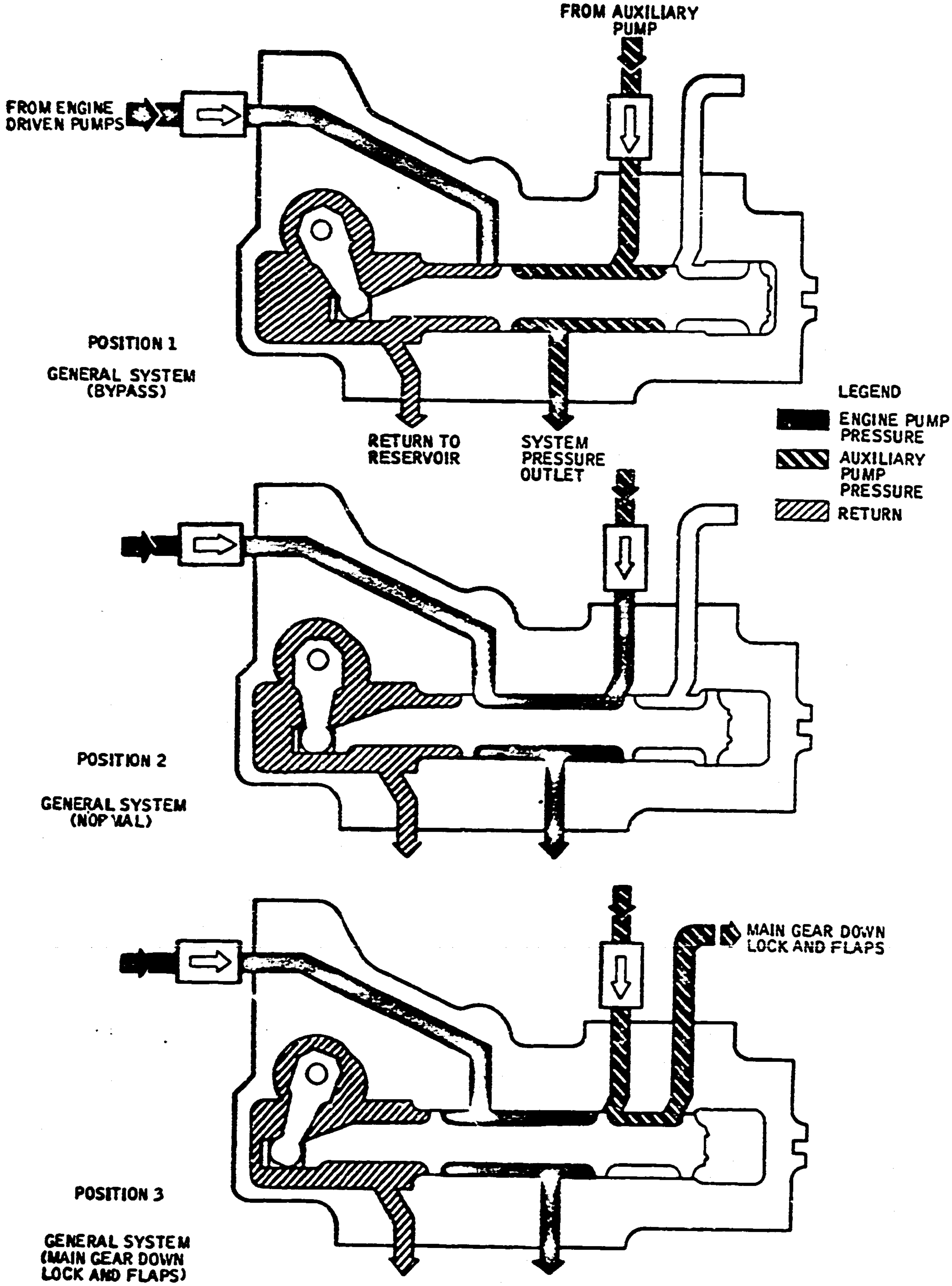
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

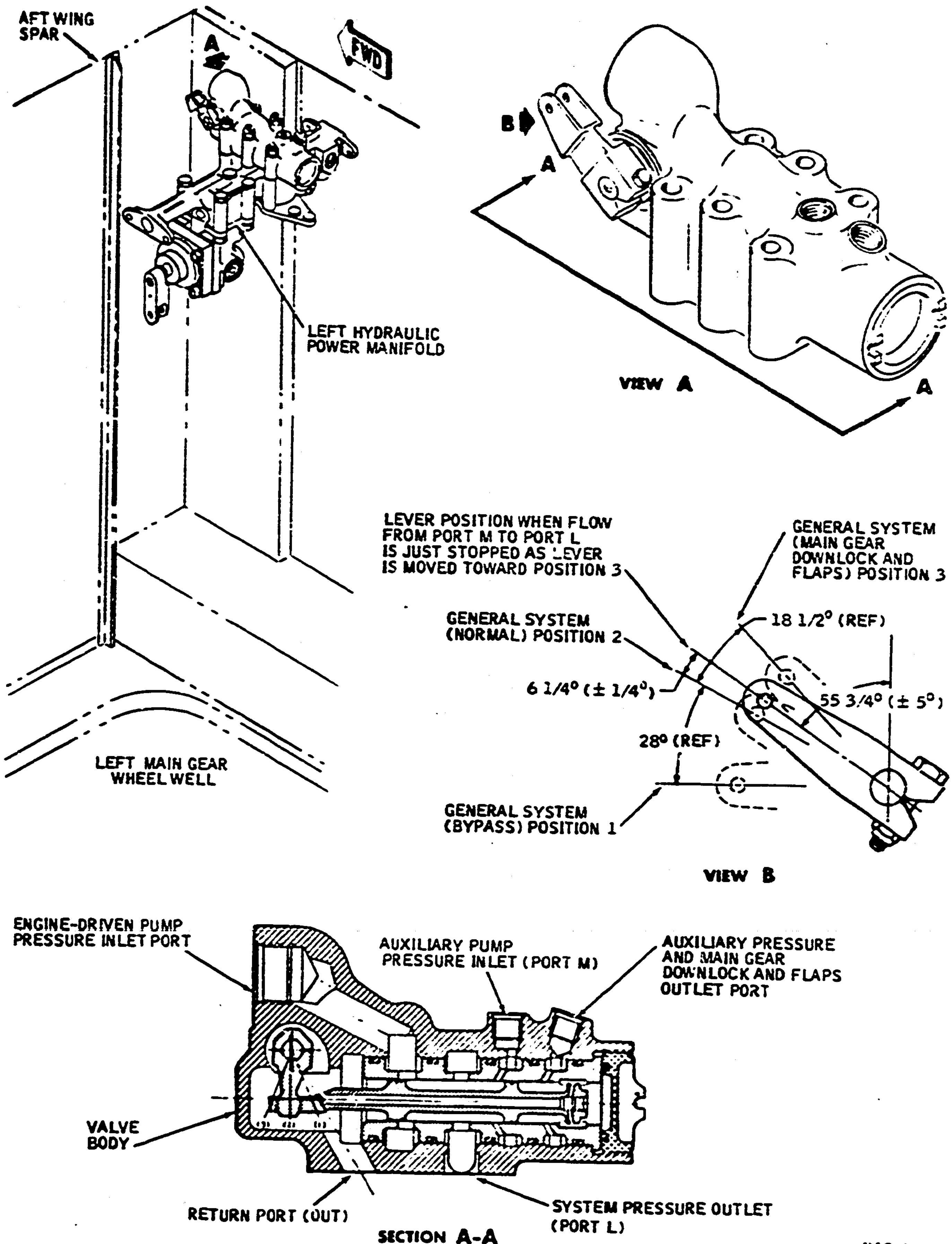
(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port. at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 18.)

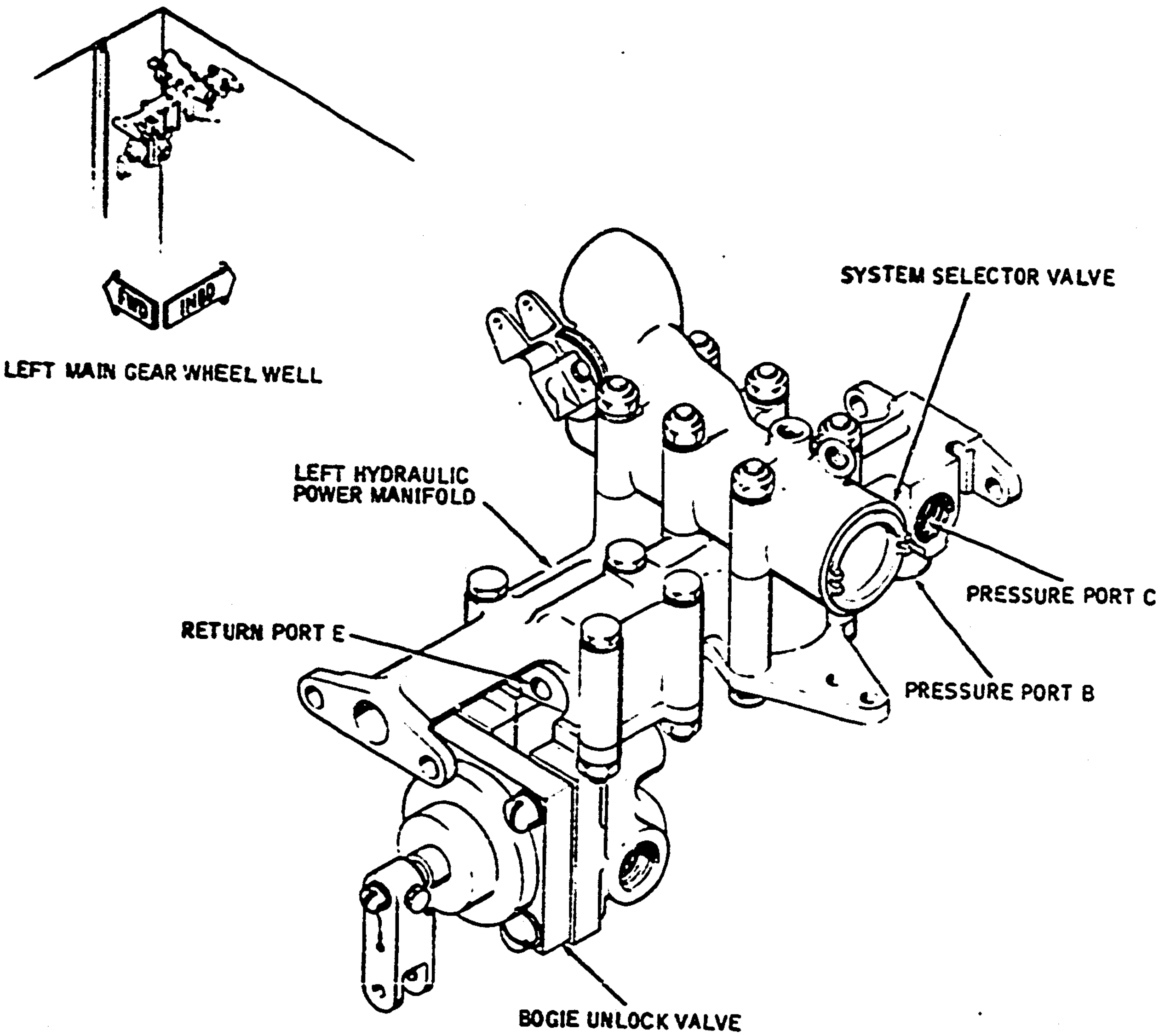
(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

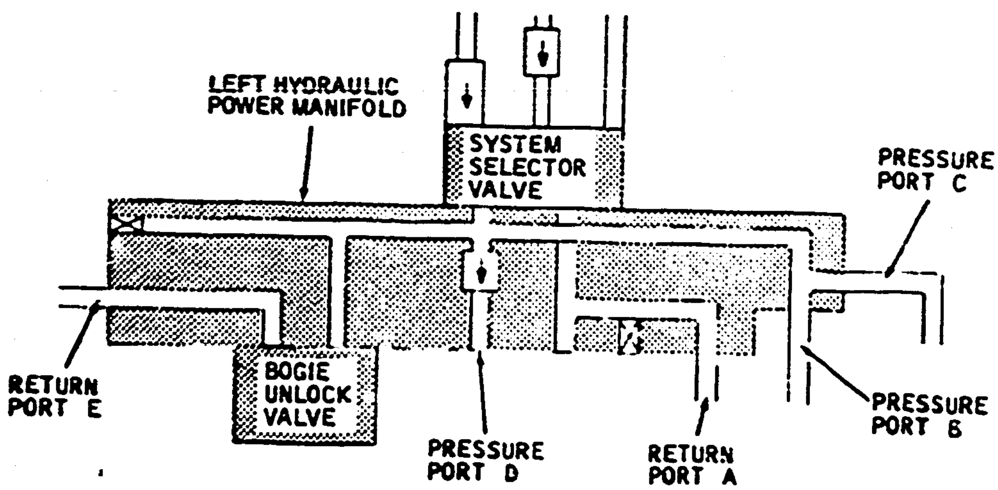


System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17





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Left Hydraulic Power Manifold -- Schematic
Figure 18

(2) Three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold pressure outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

G. Right Hydraulic Power Manifold (See Figure 19.)

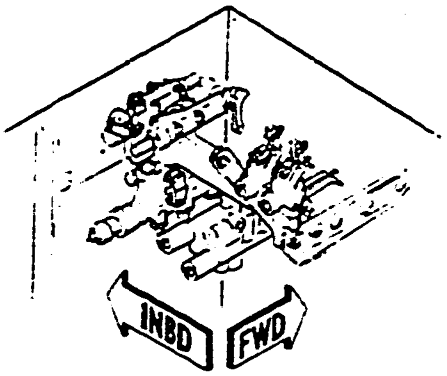
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

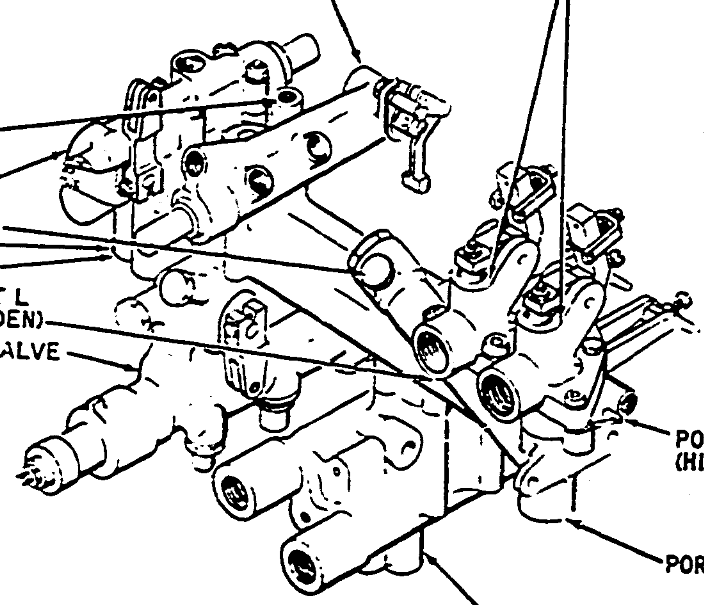
(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

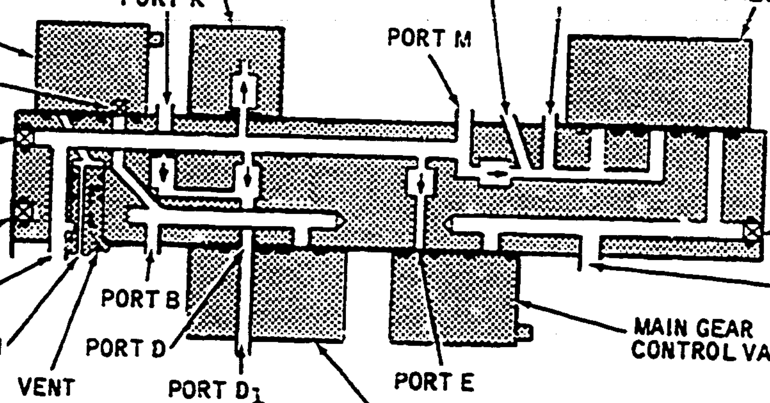
(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.



RIGHT MAIN GEAR WHEEL WELL



NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19

R. Hydraulic Manifold Return Check Valves (See Figure 10.)

(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.

S. Hydraulic Power System Accumulator (See Figure 20.)

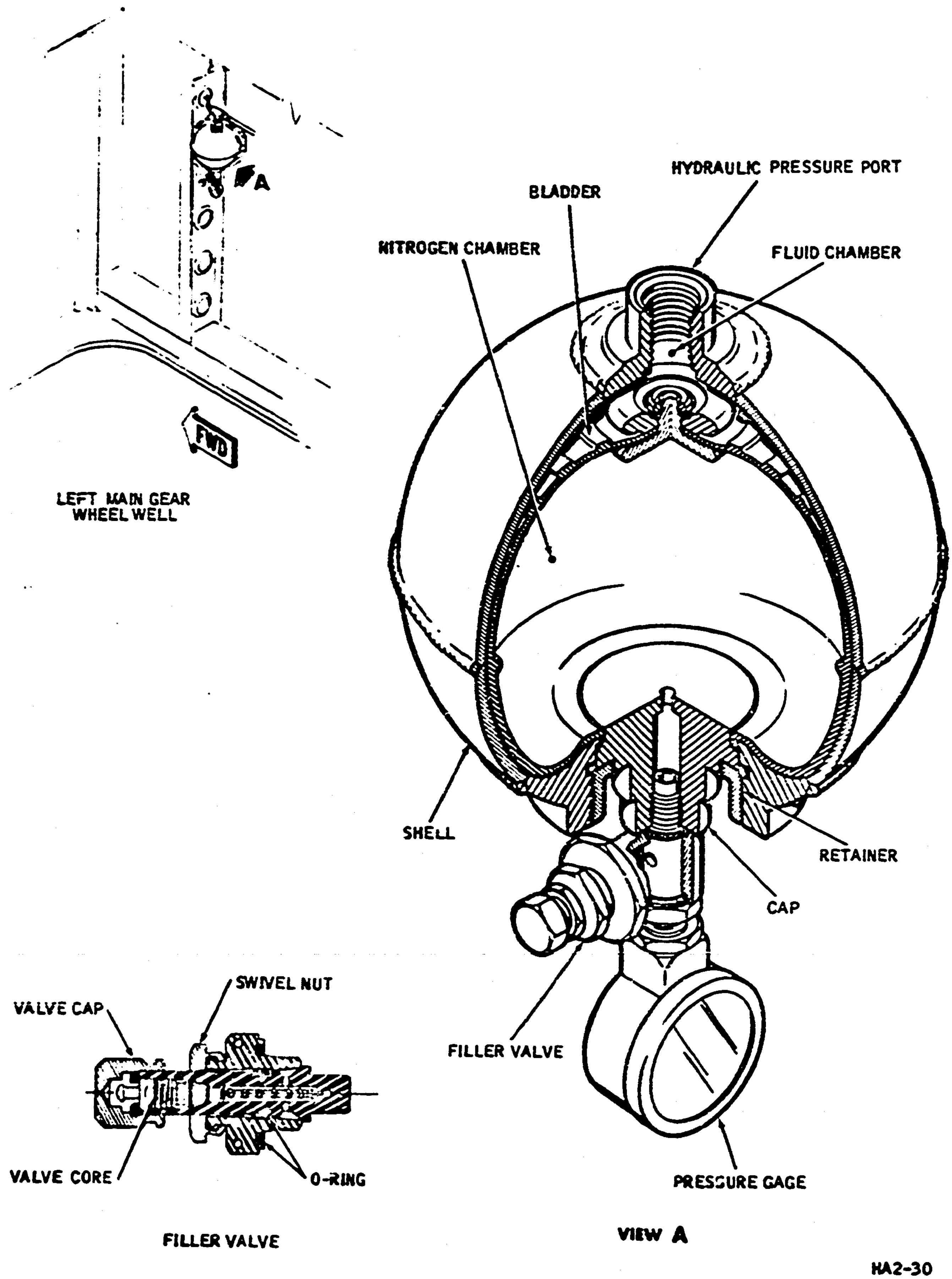
(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

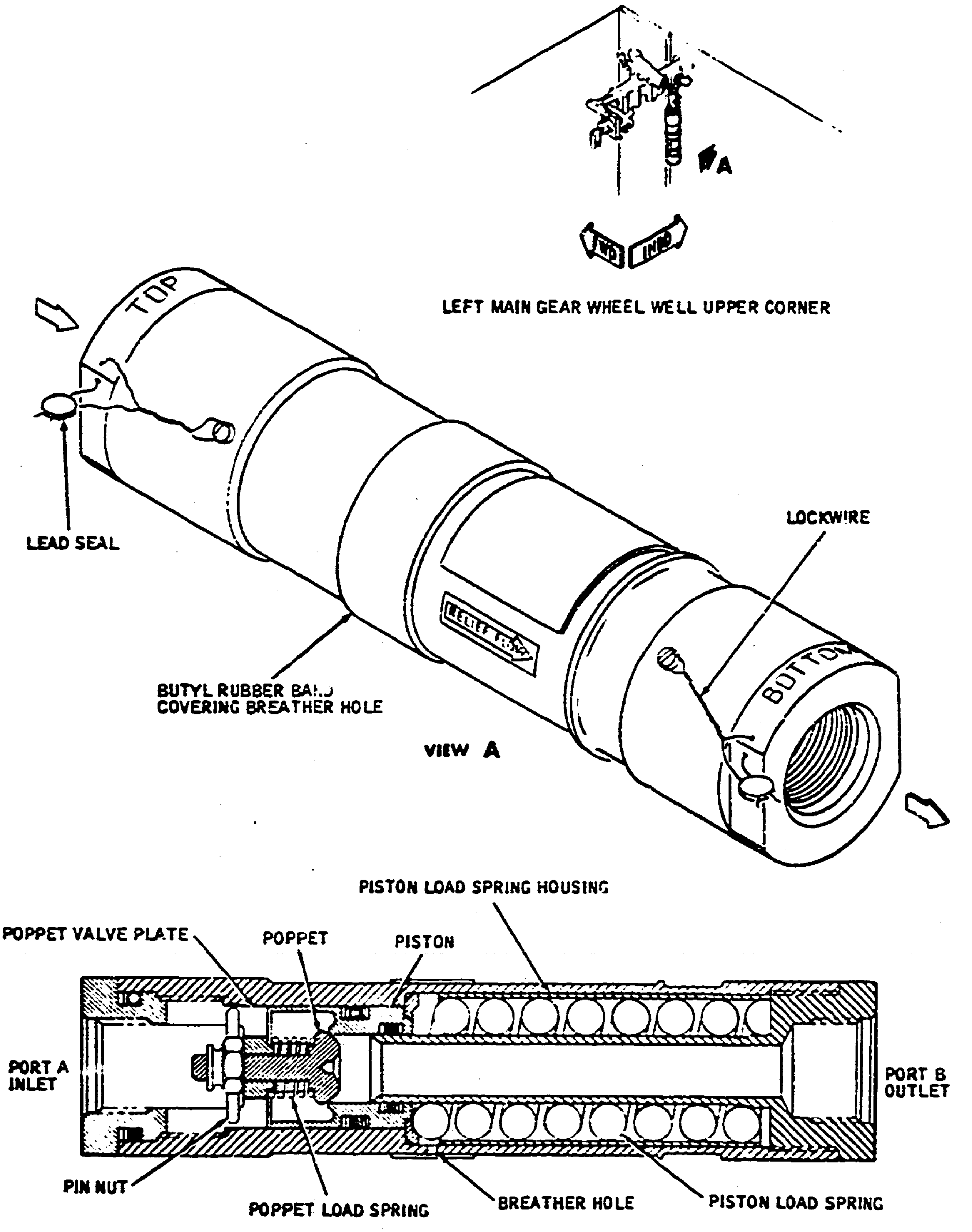
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.



Hydraulic Power System Accumulator --
Cutaway View
Figure 20



Hydraulic System Priority Valve -- Cutaway View
Figure 21

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system

engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the

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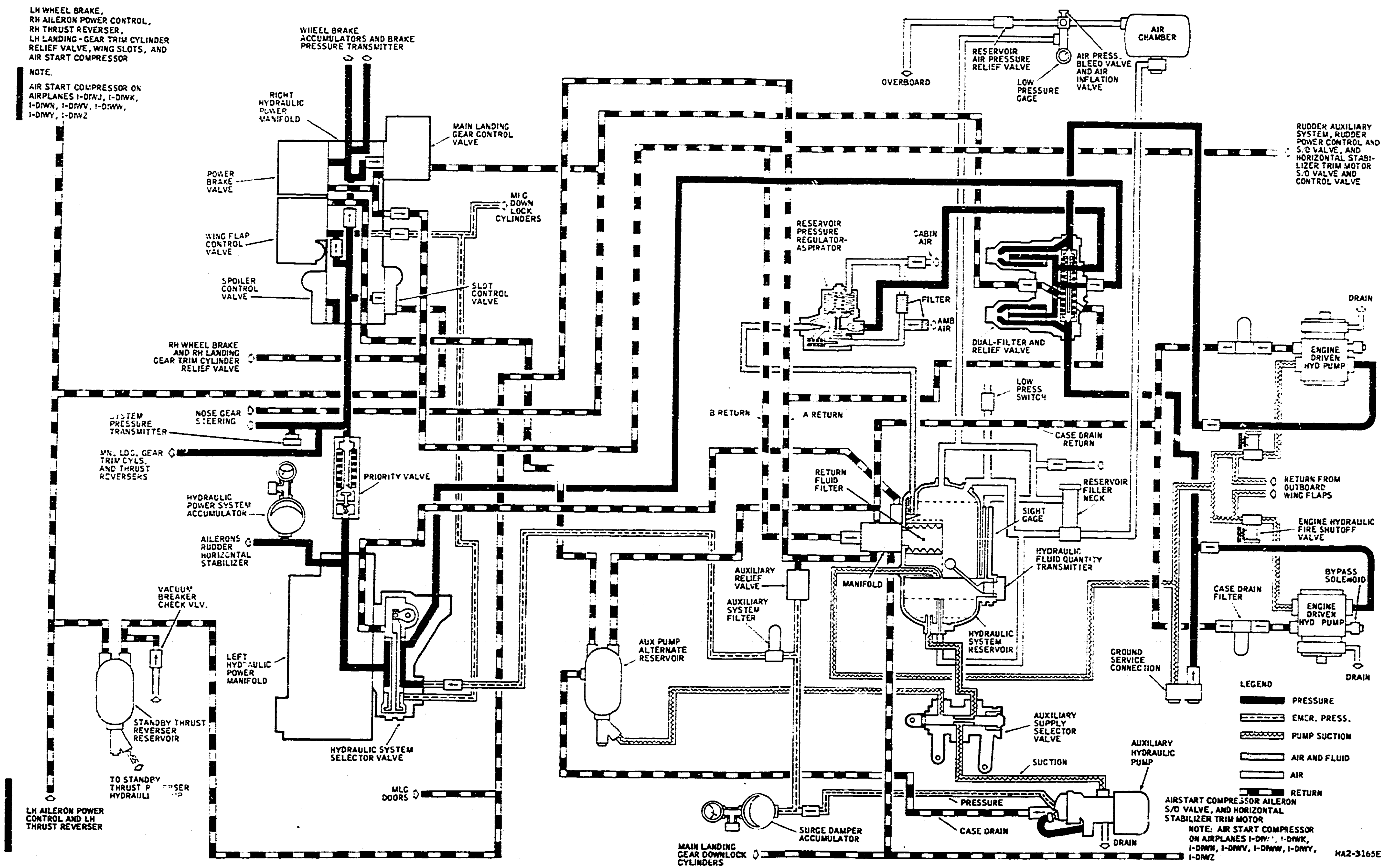

Hydraulic Power System -- Schematic Diagram
Figure 1

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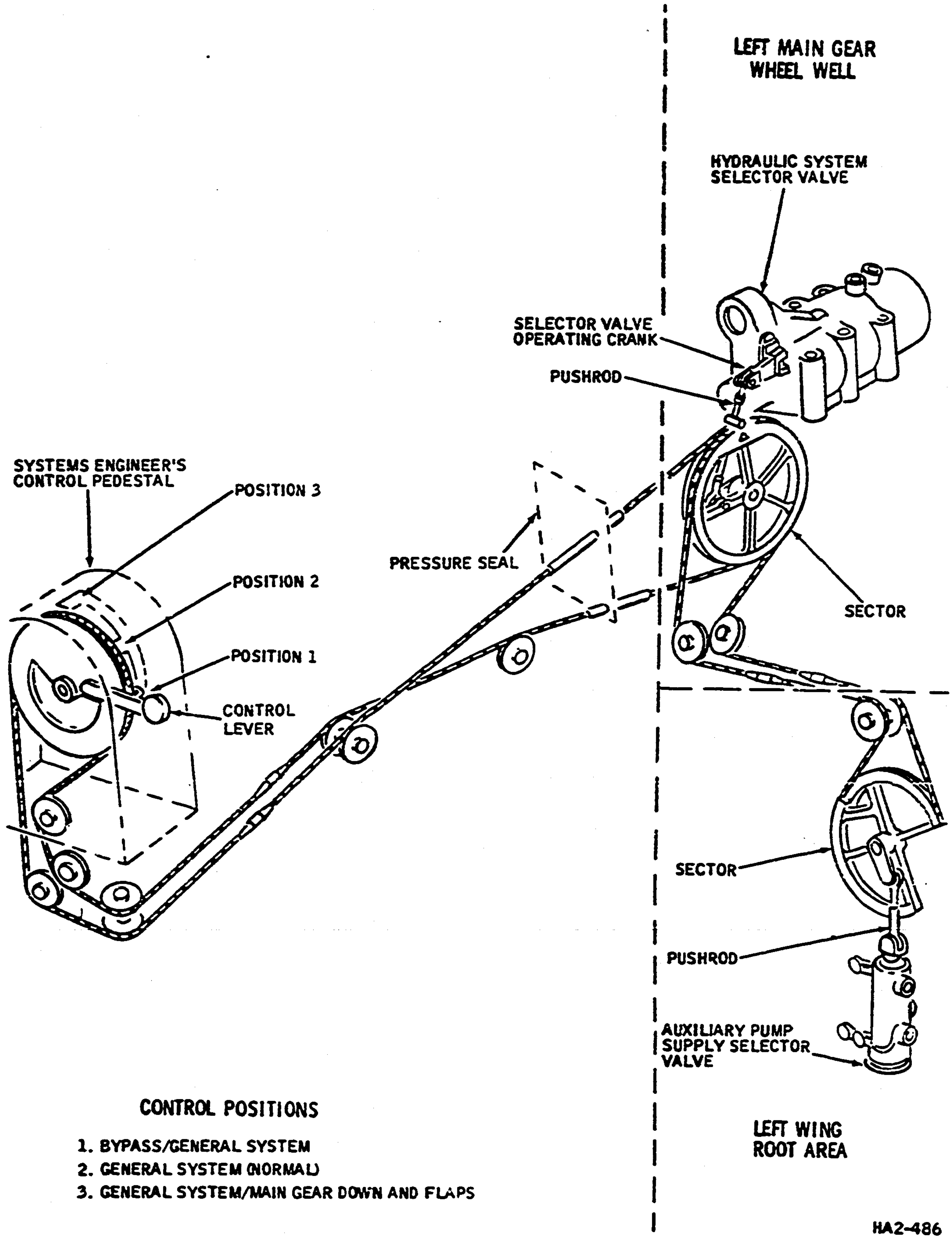


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

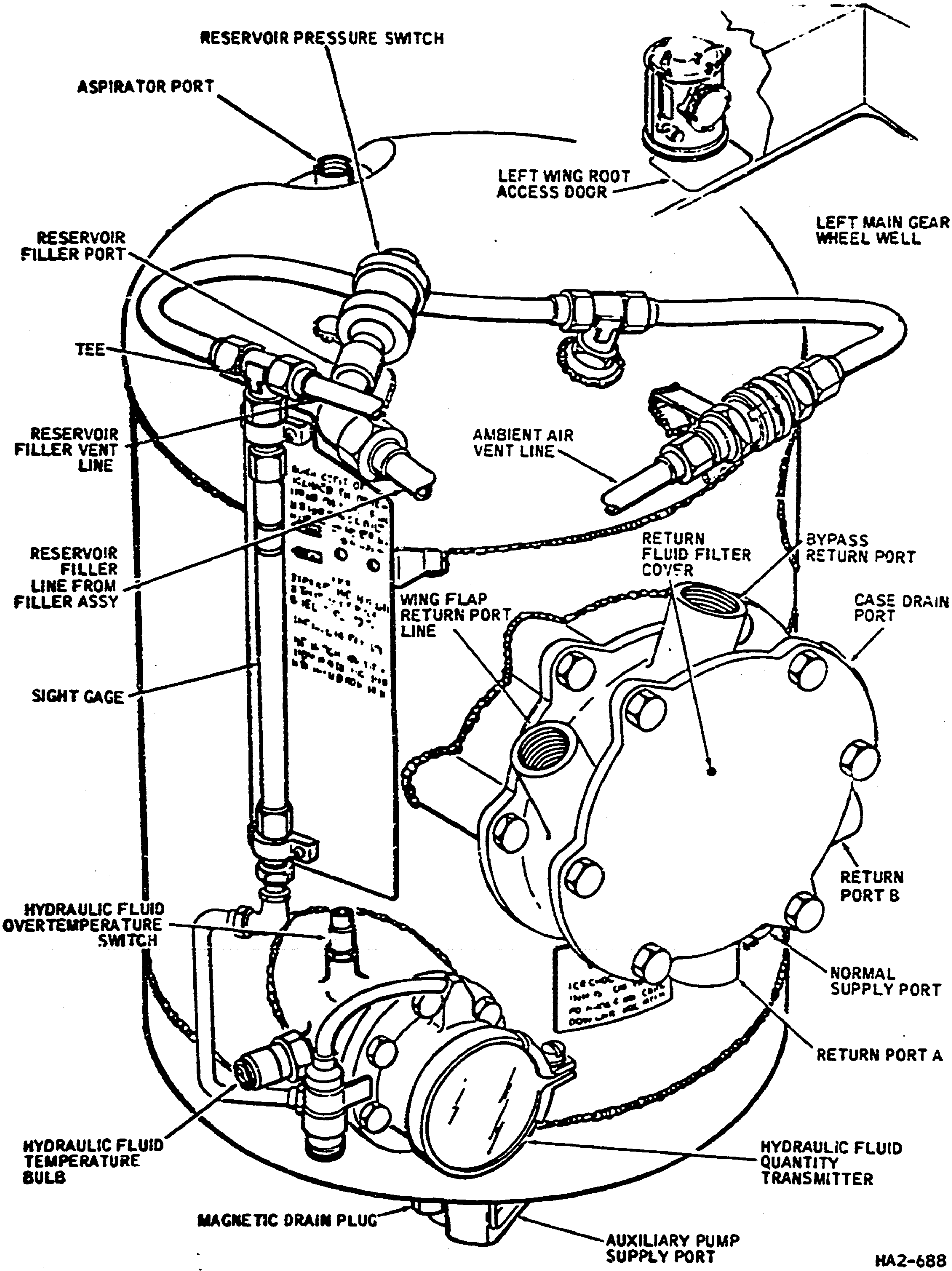
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

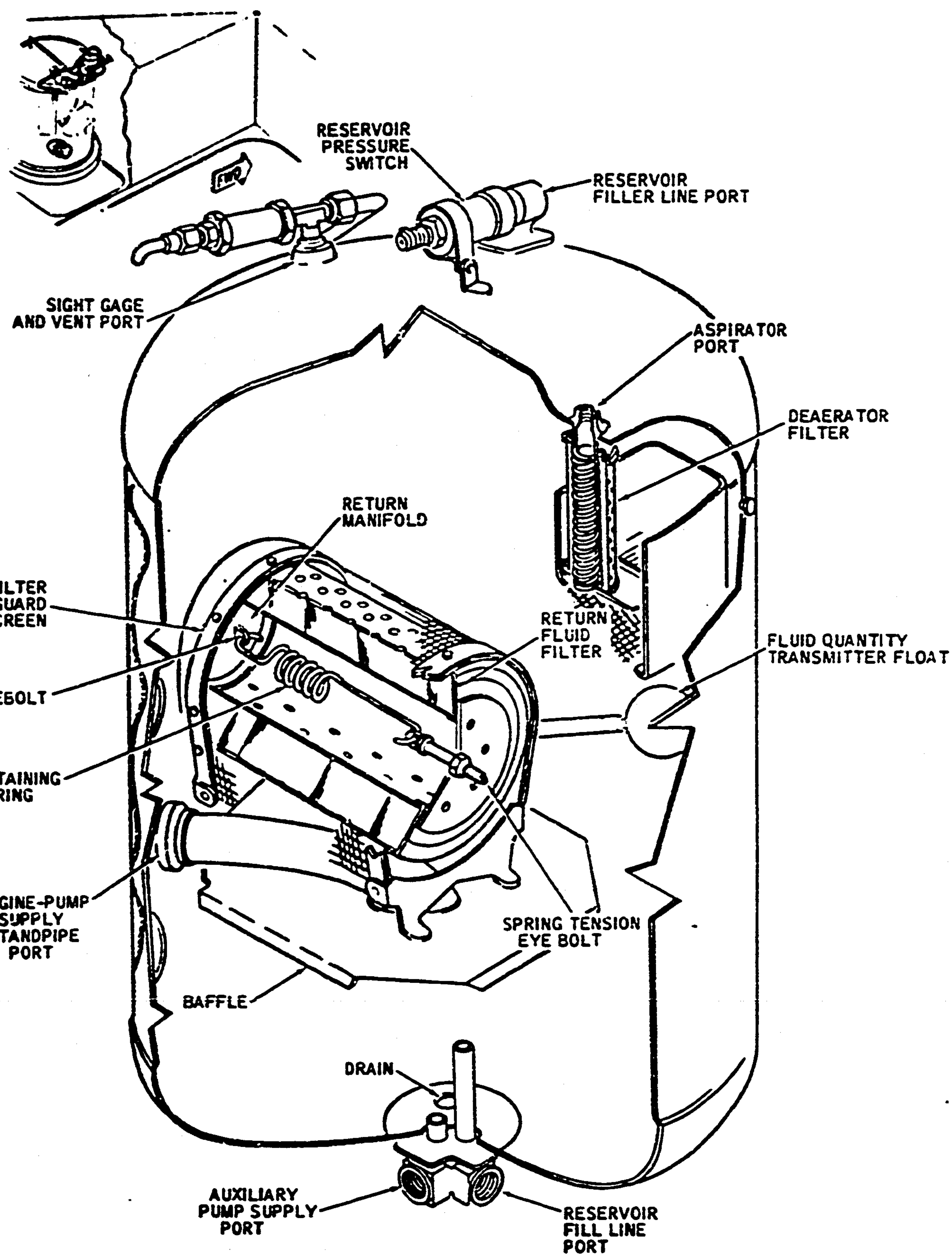
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main



Hydraulic System Reservoir -- External View
Figure 3



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Hydraulic System Reservoir -- Cutaway View
Figure 4

source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

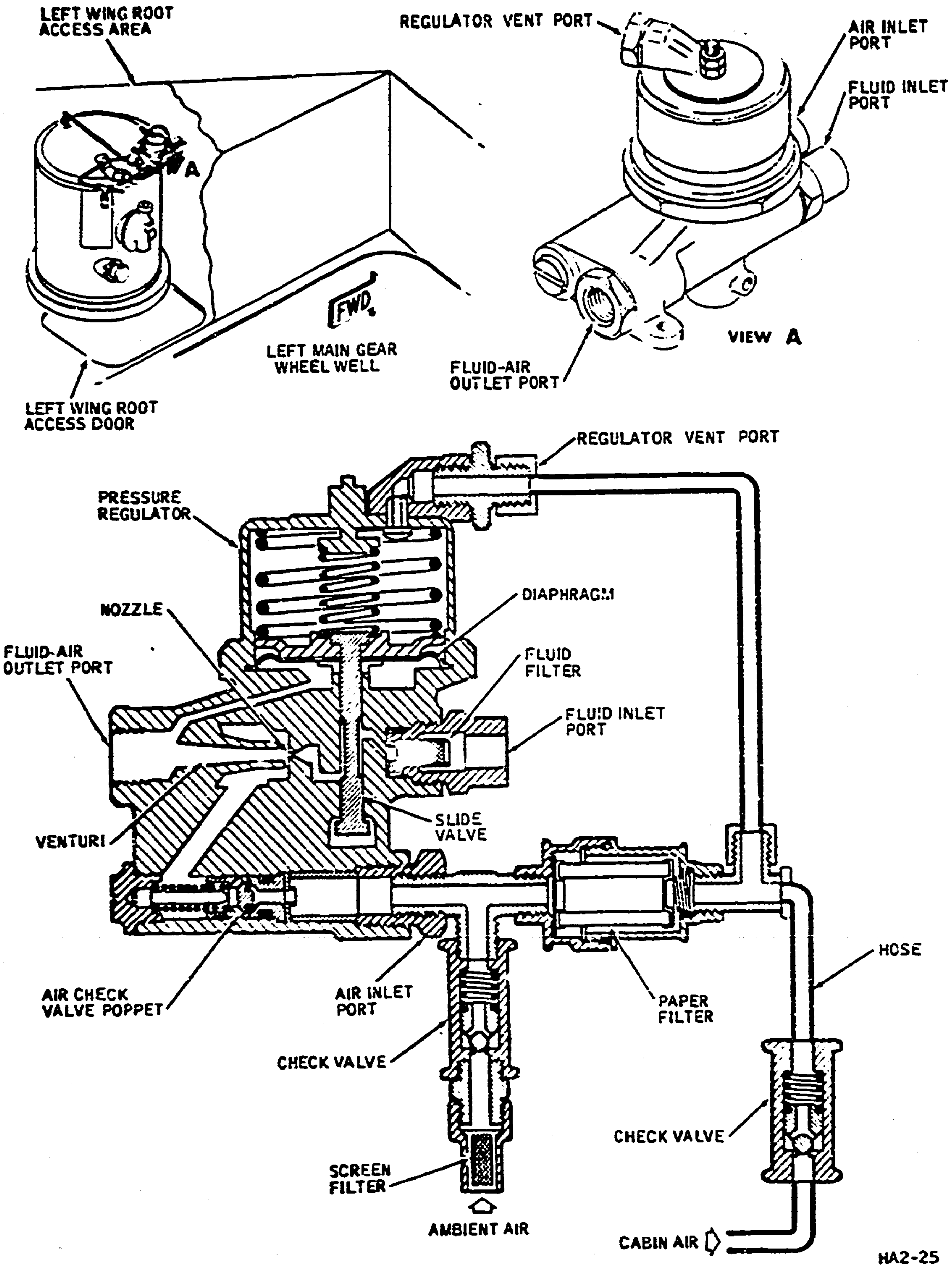
(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

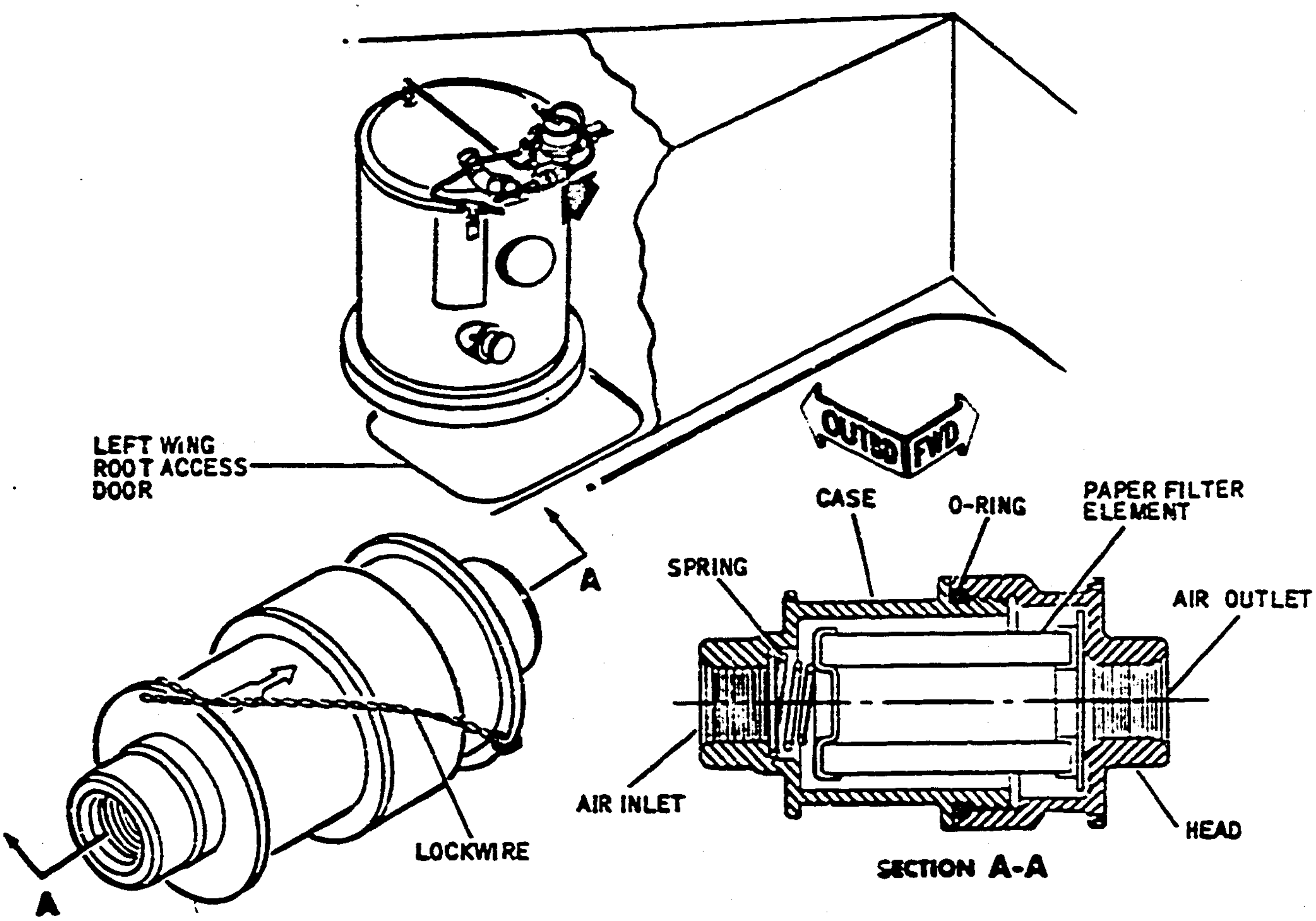
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

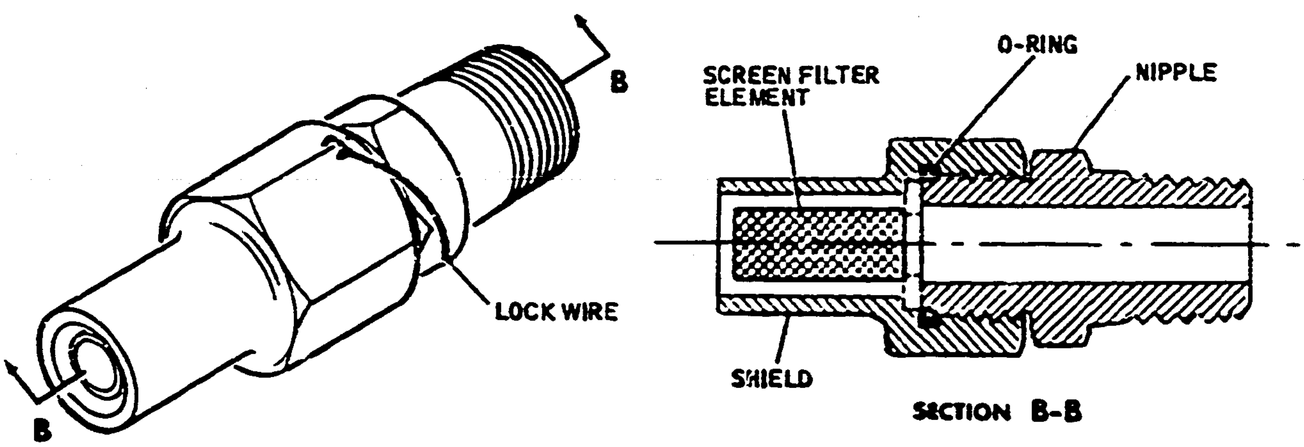
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.



PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

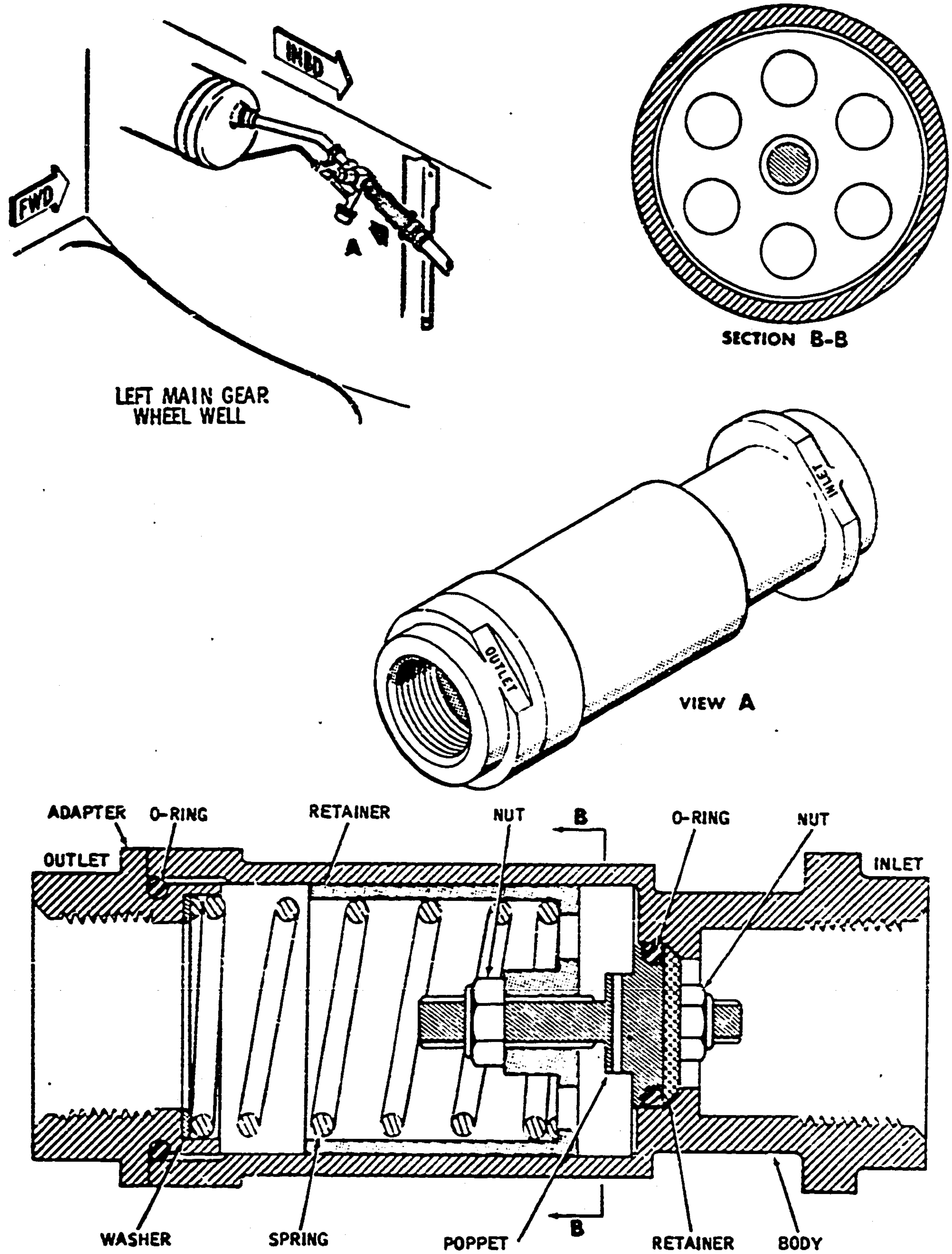
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber.



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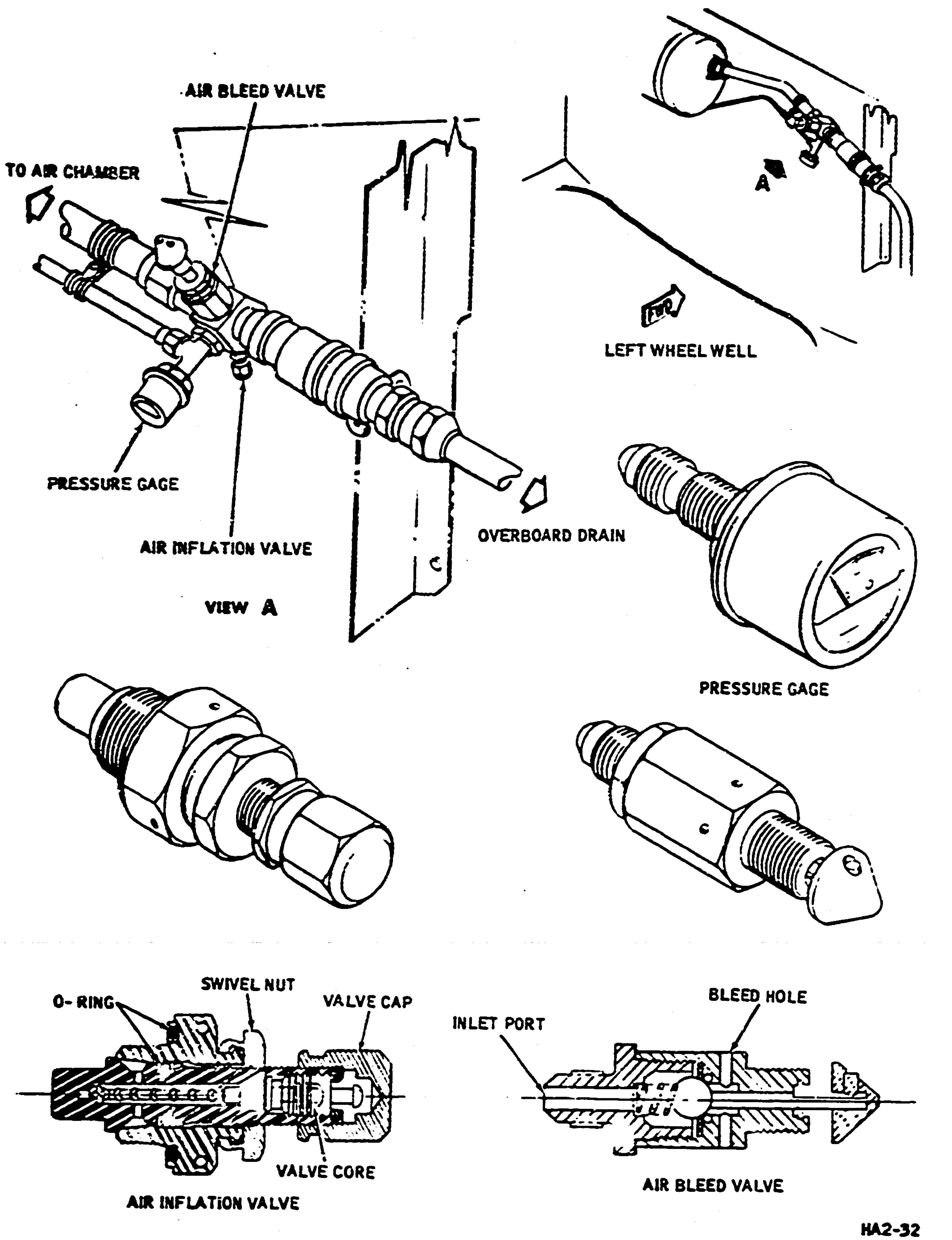
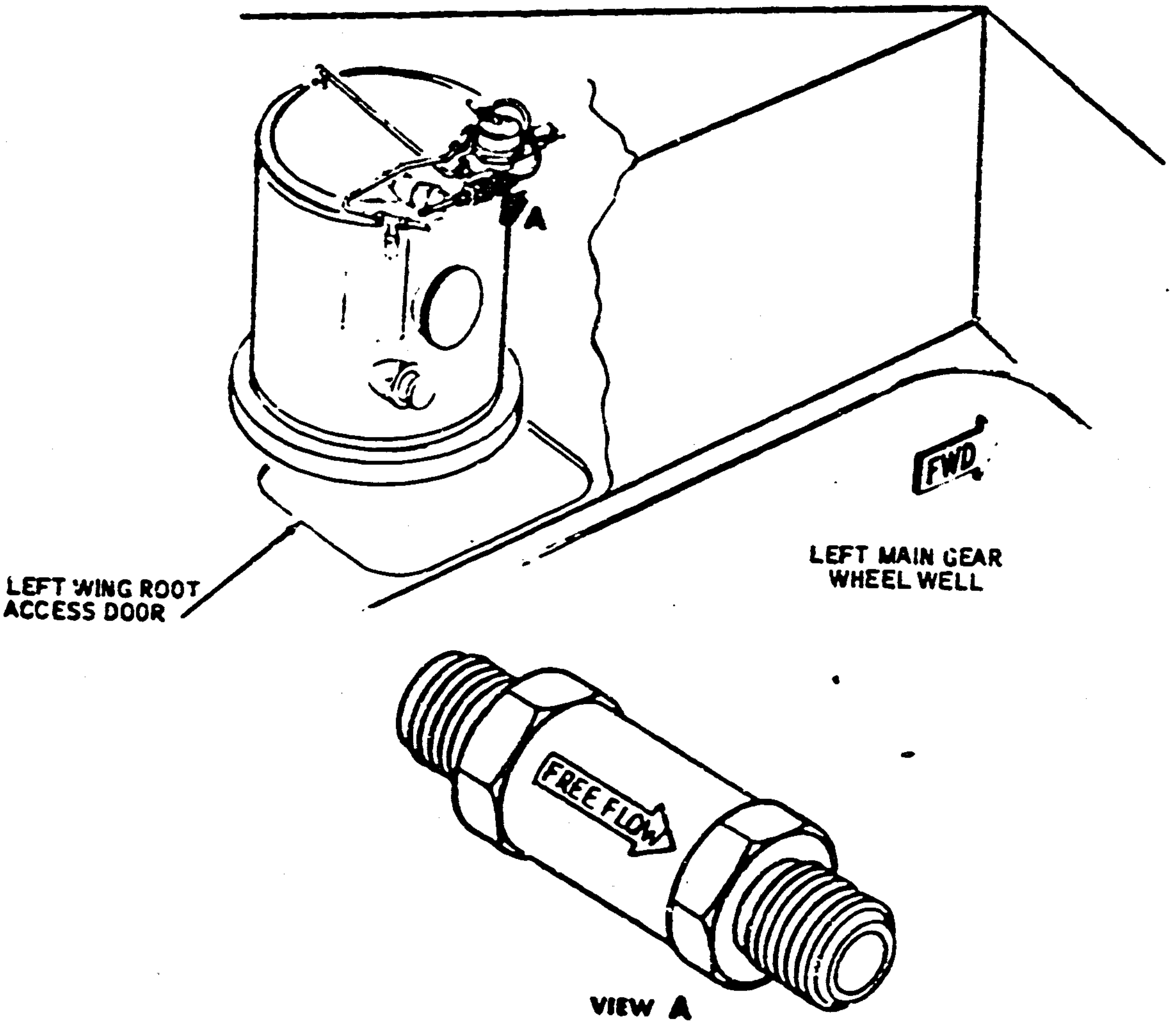
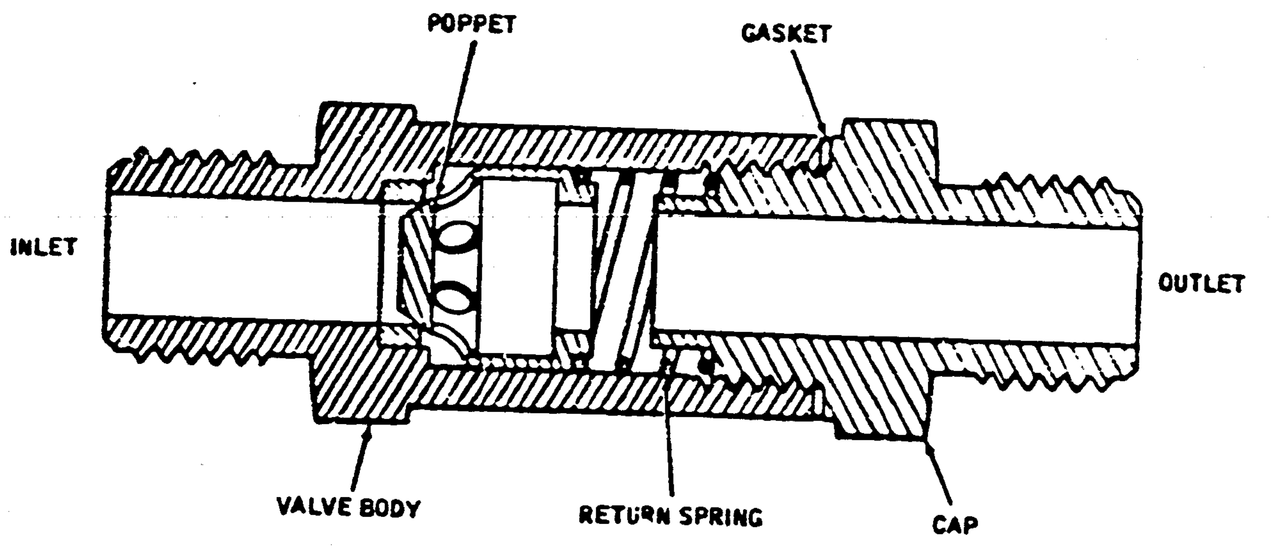
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8





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Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

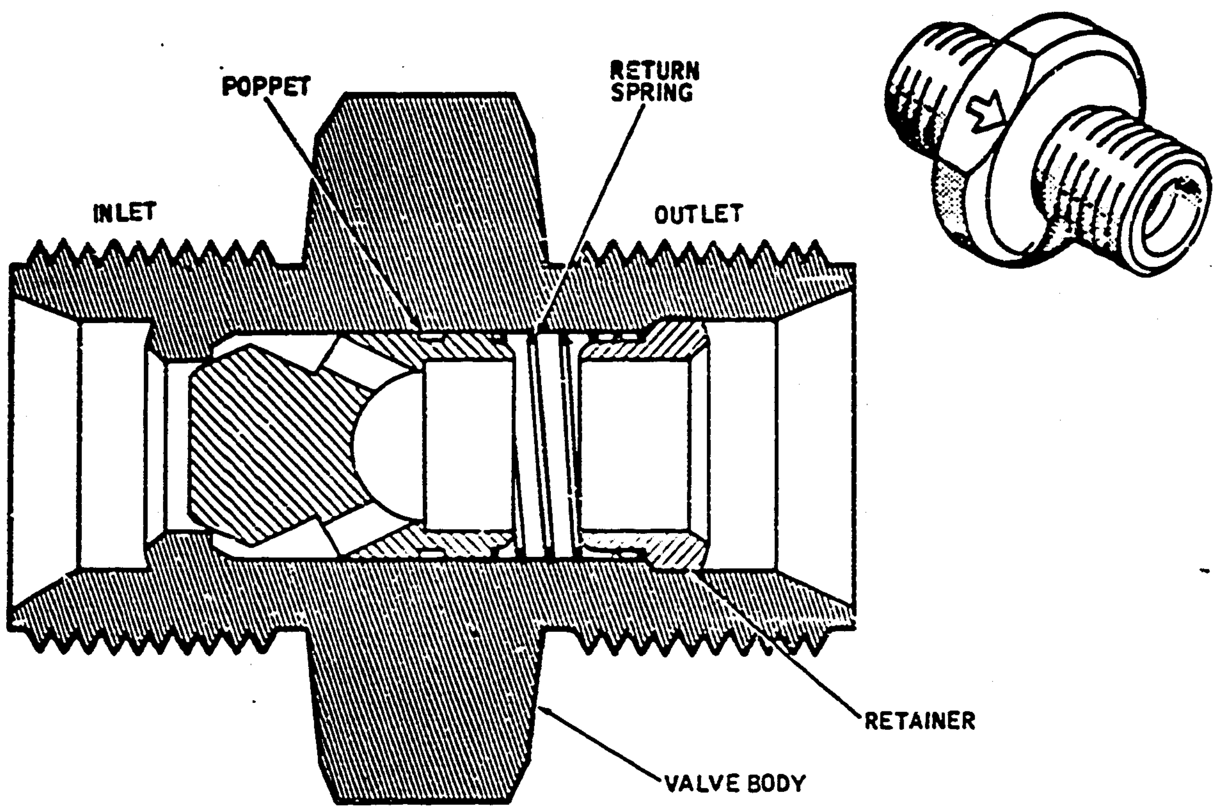
(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

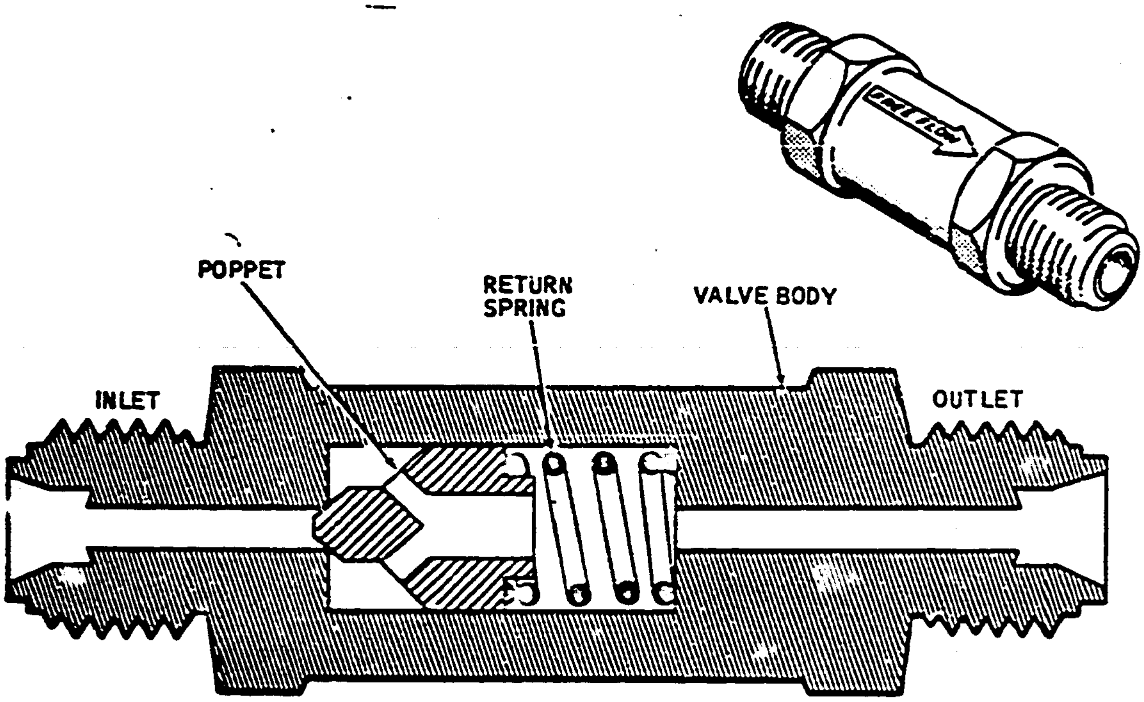
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

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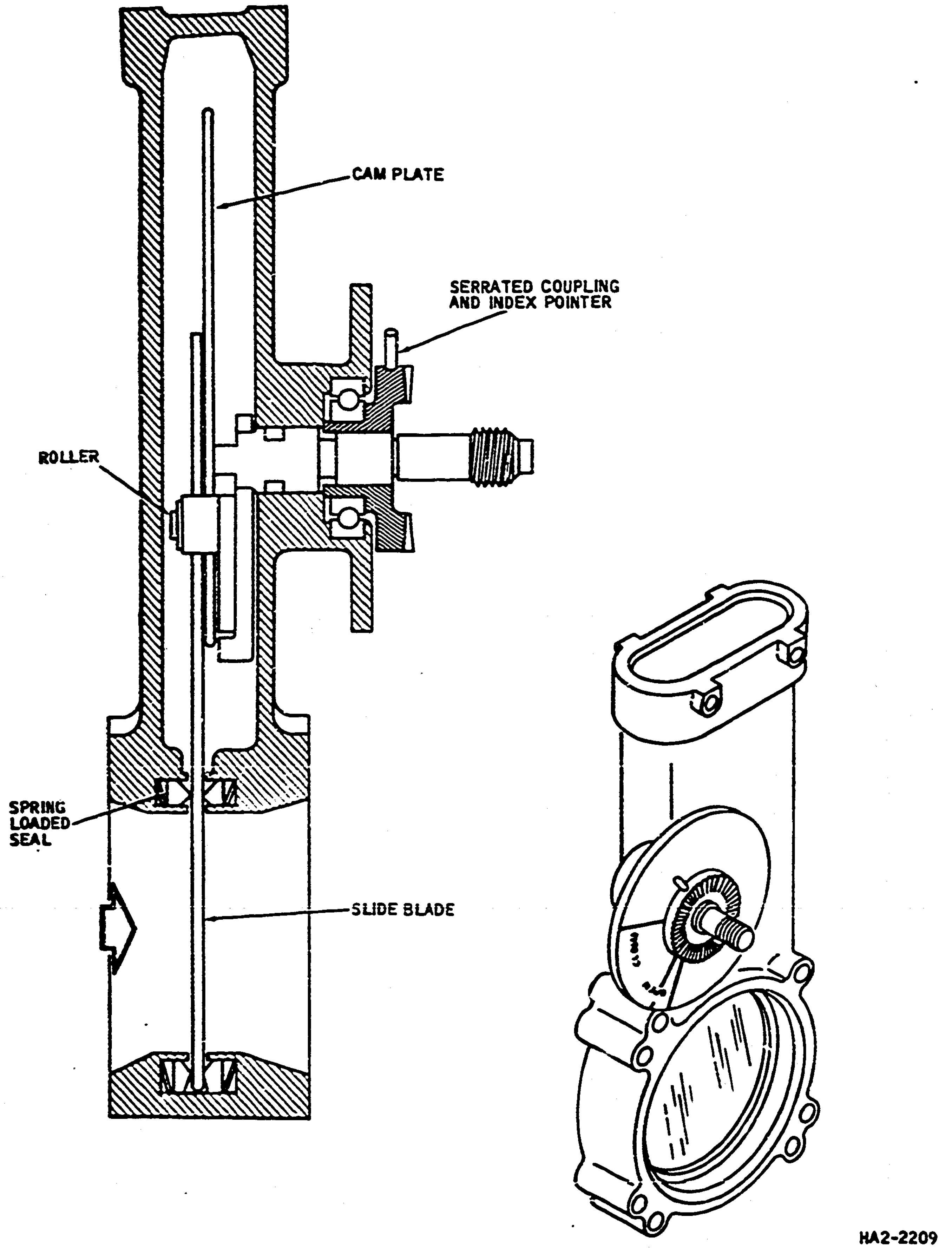
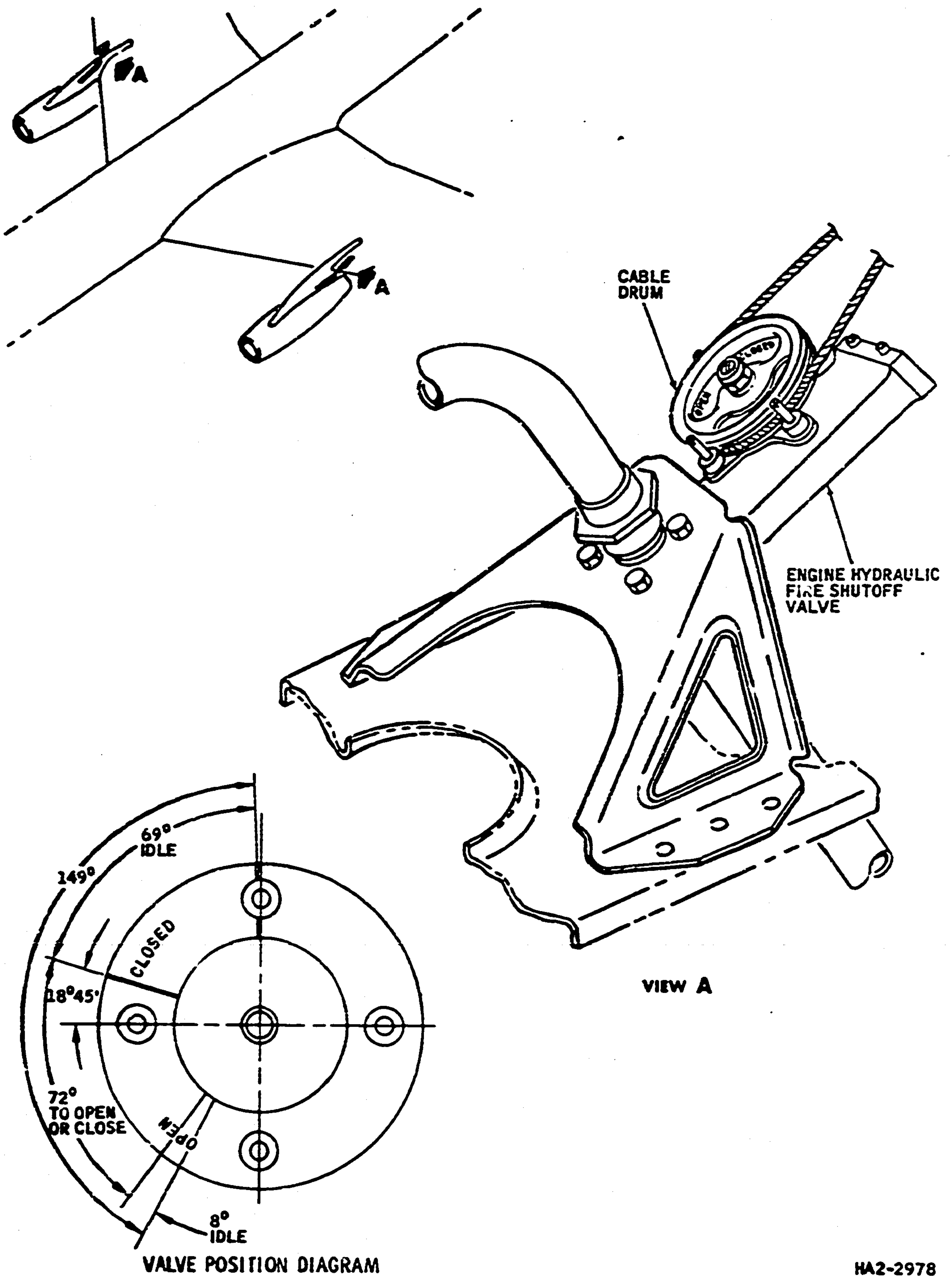
Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

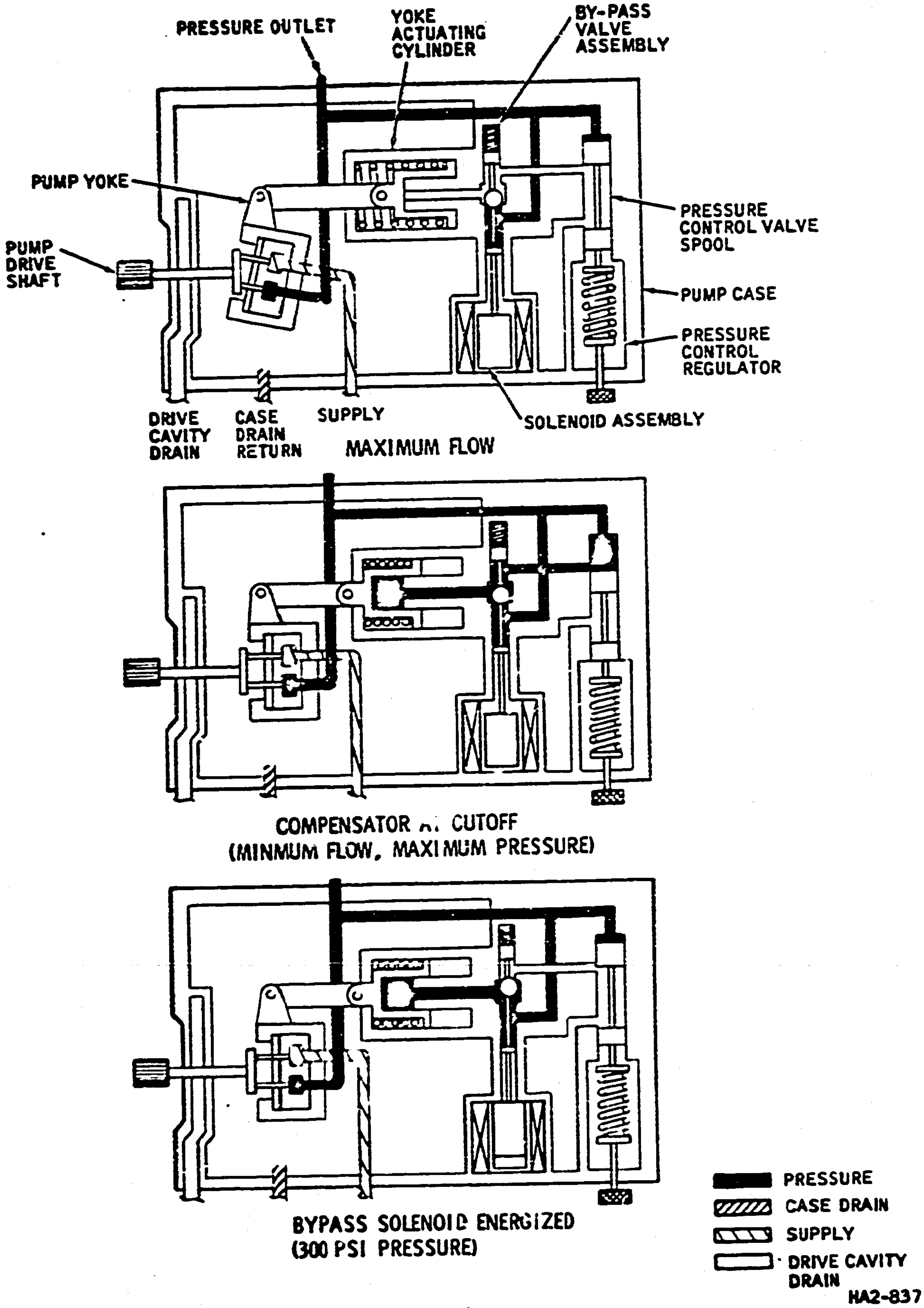
(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated, by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it over-center. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the



Engine-Driven Hydraulic Pump Pressure-Flow -- Schematic
Figure 13

yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating driven shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring,

will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

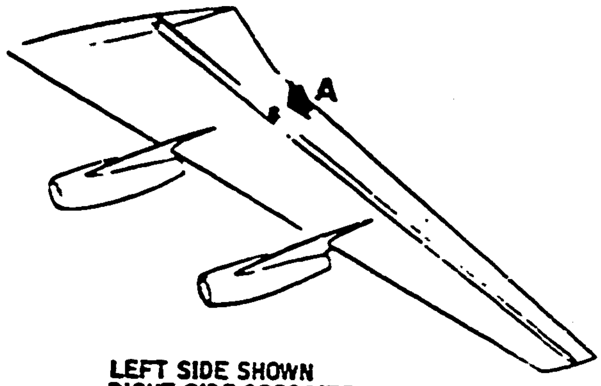
N. Dual Filter and Relief Valve (See Figure 15.)

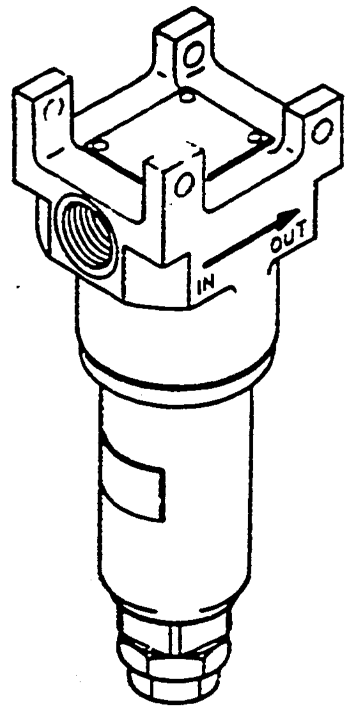
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

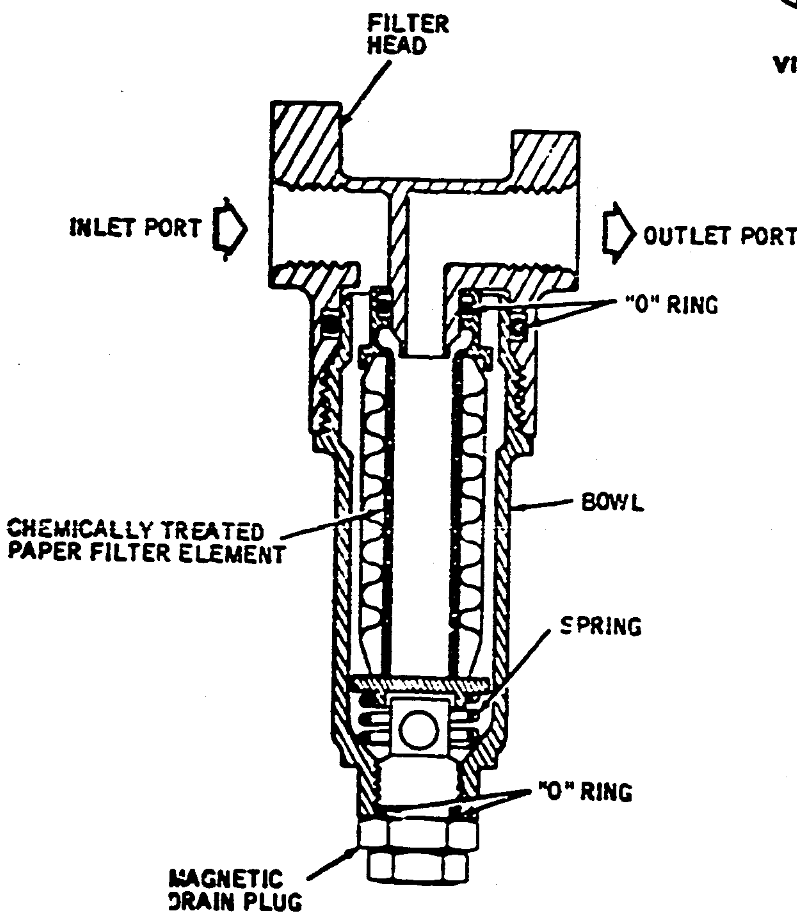
(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

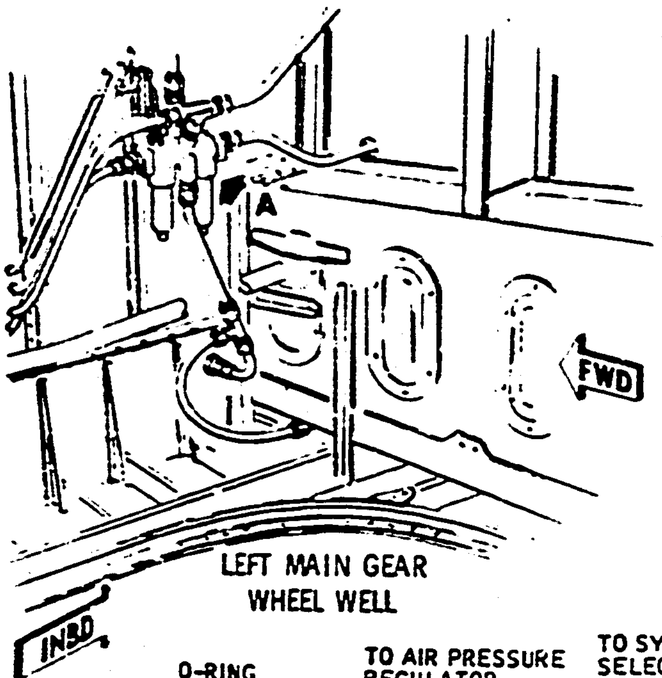


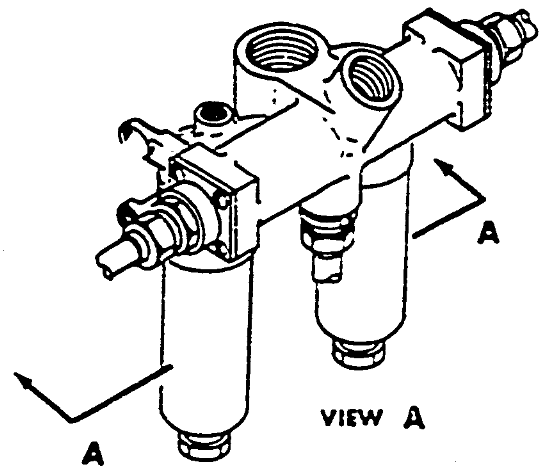


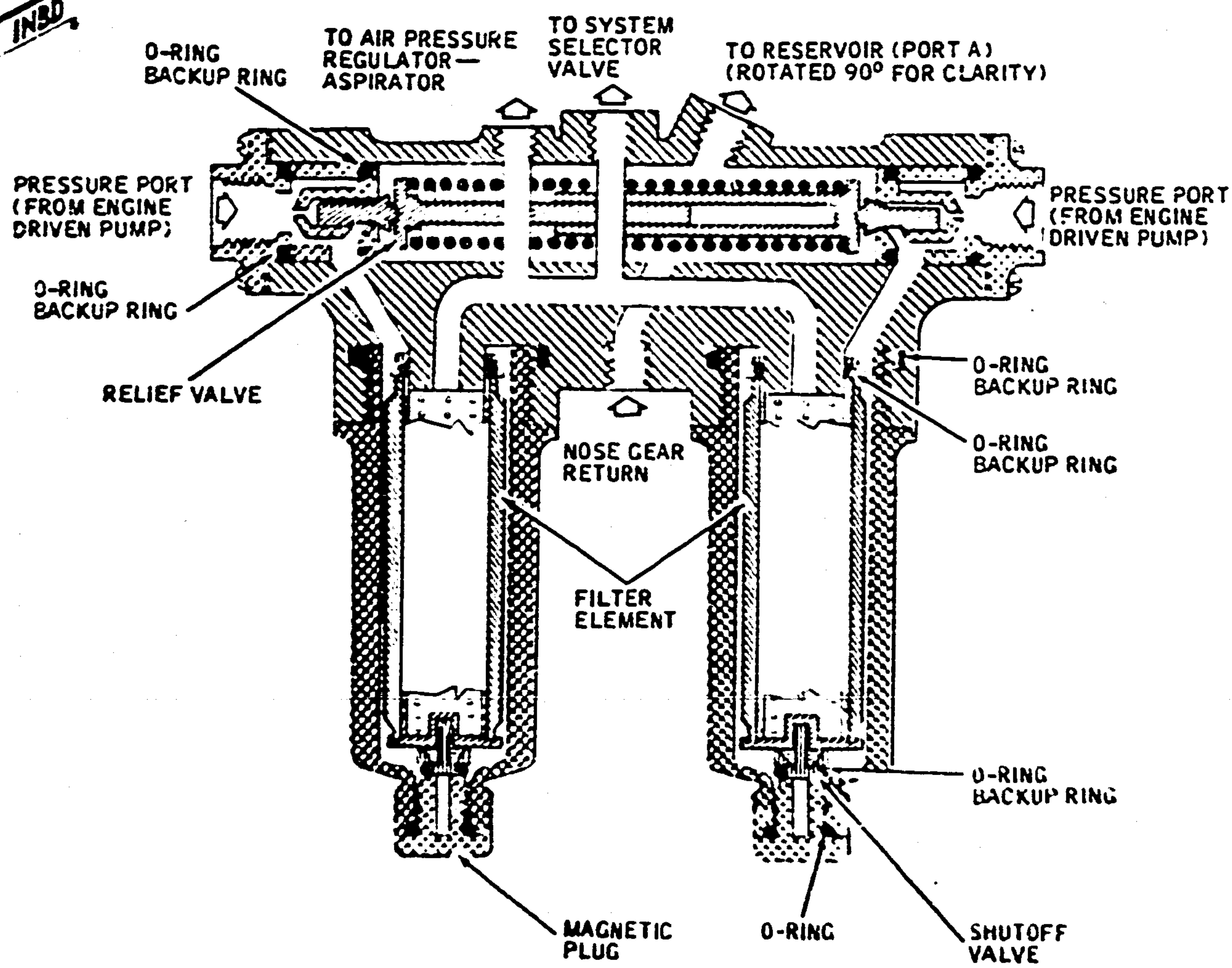


HA2-31

Engine Driven Hydraulic Pump Case Drain Filter -- Cutaway View
Figure 14







SECTION A-A

HA2-20

Dual-Filter and Relief Valve -- Cutaway Valve
Figure 15

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

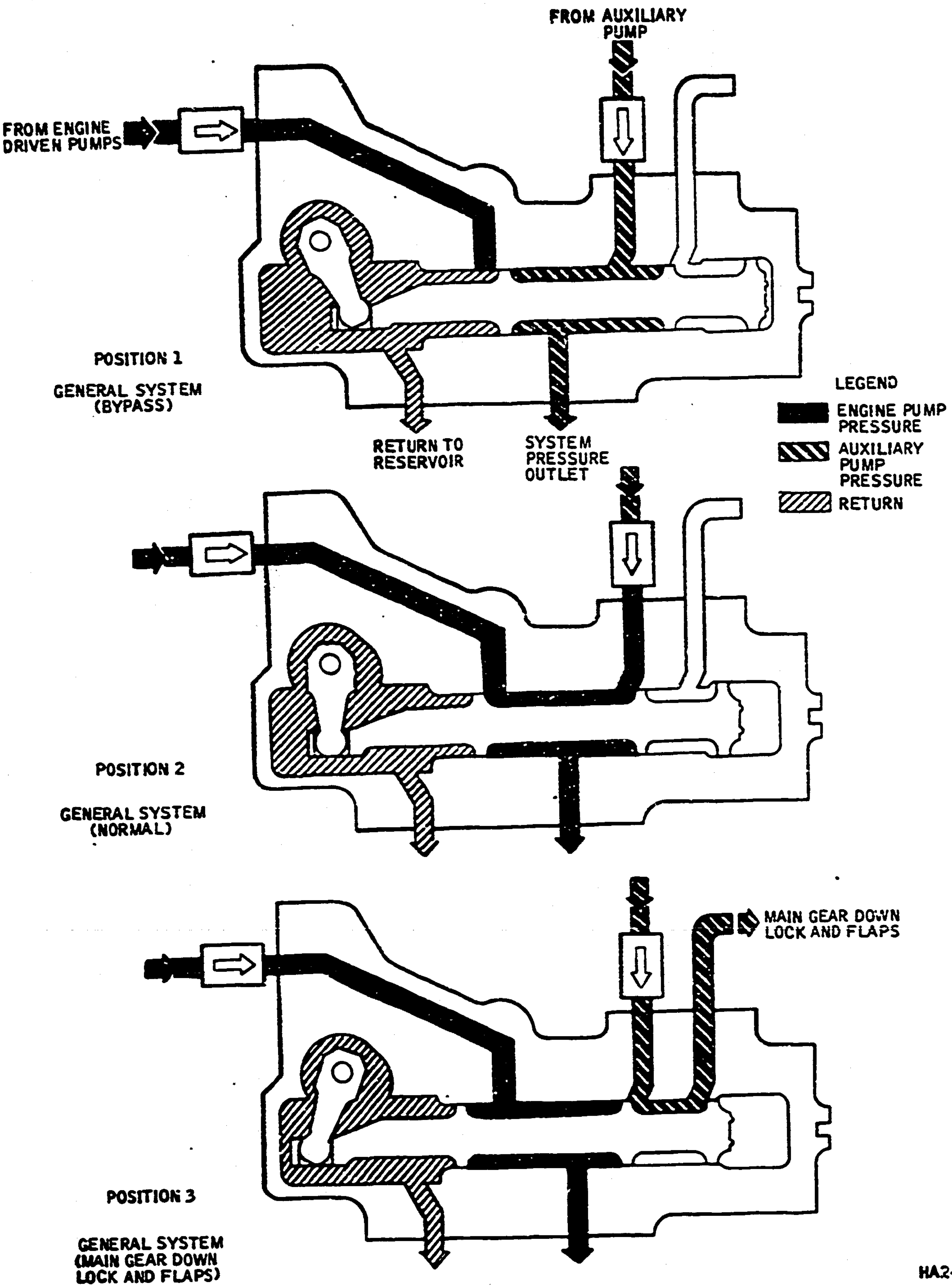
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

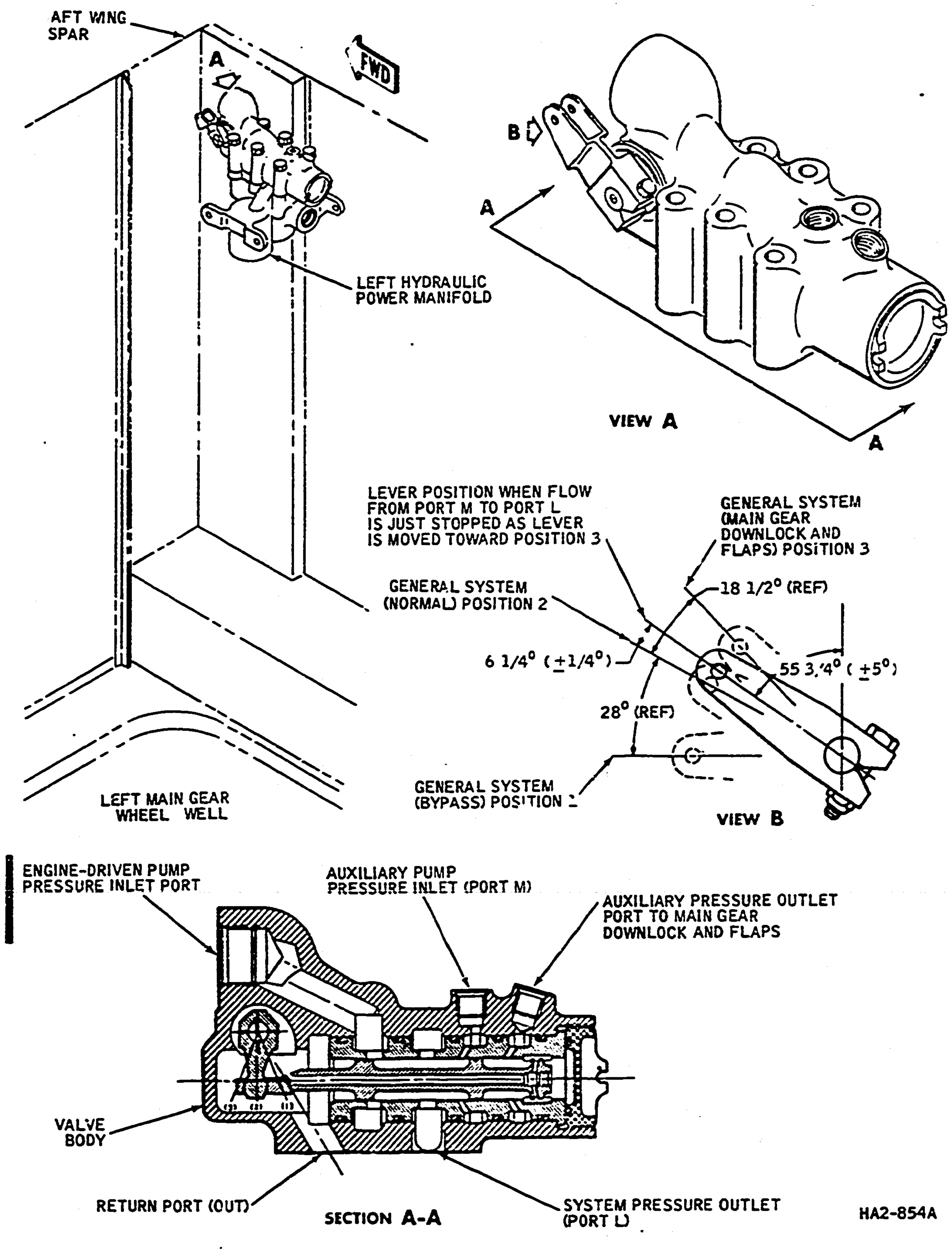
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

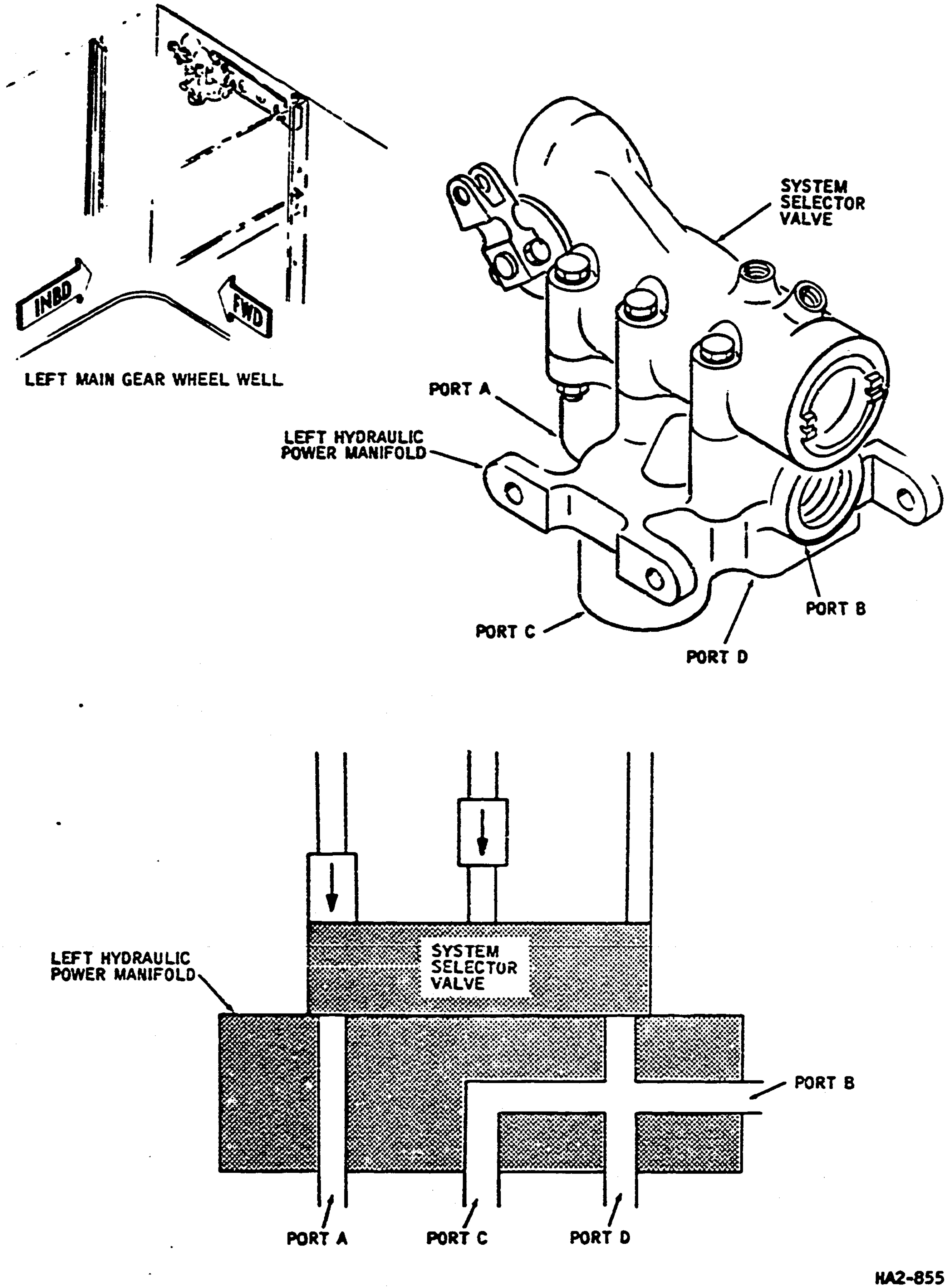
(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17



Left Hydraulic Power Manifold -- Schematic
Figure 18

bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

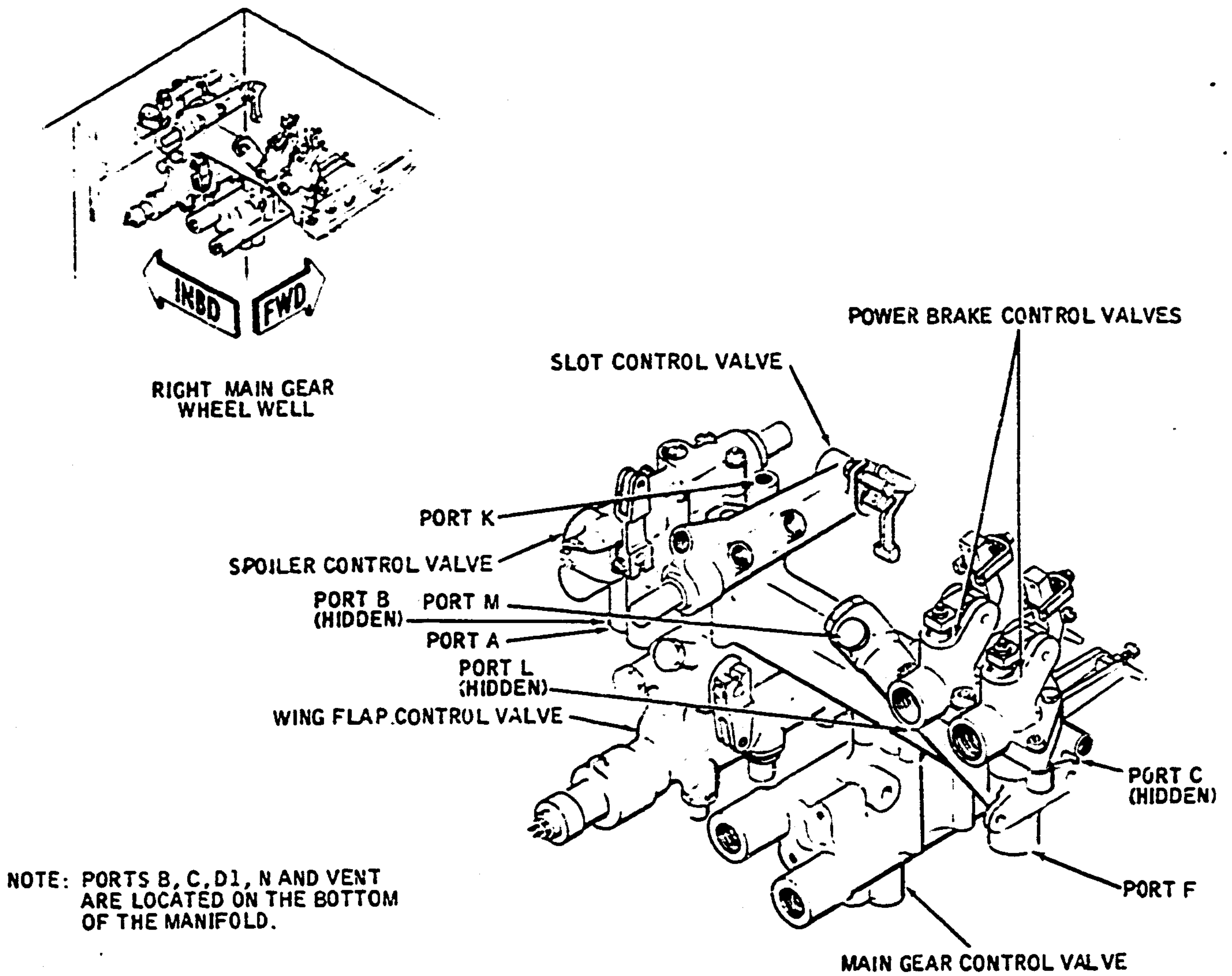
(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

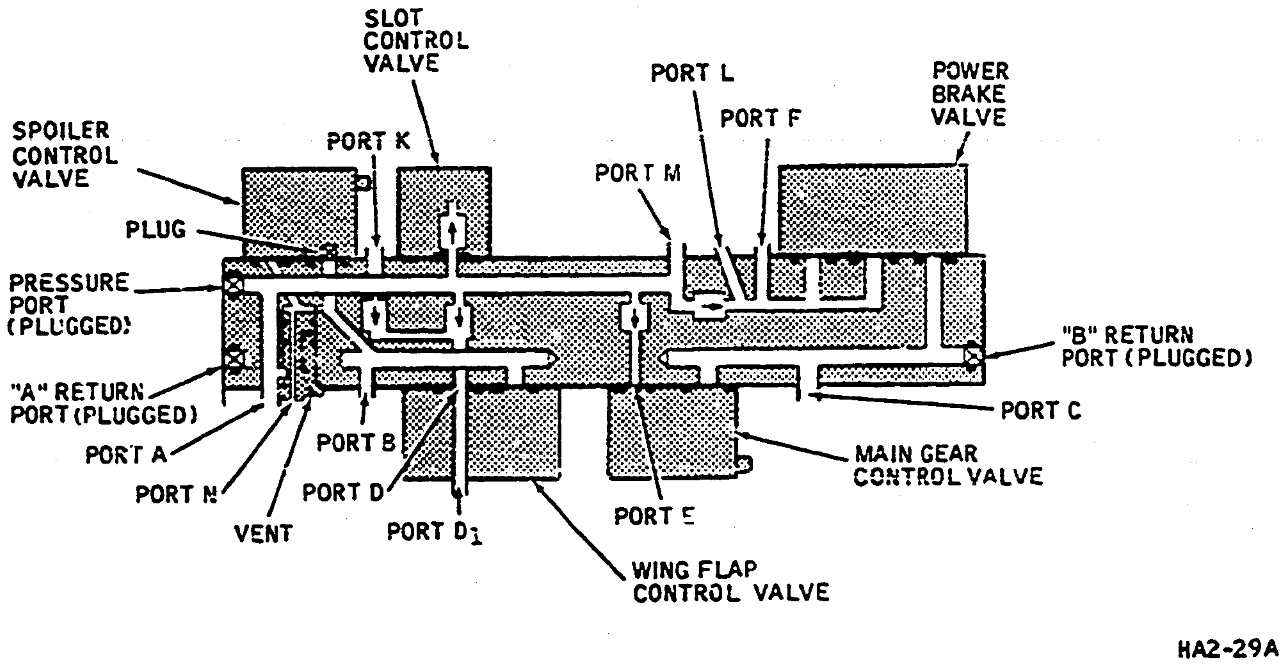
(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Deleted.





Right Hydraulic Power Manifold -- Schematic
Figure 19

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

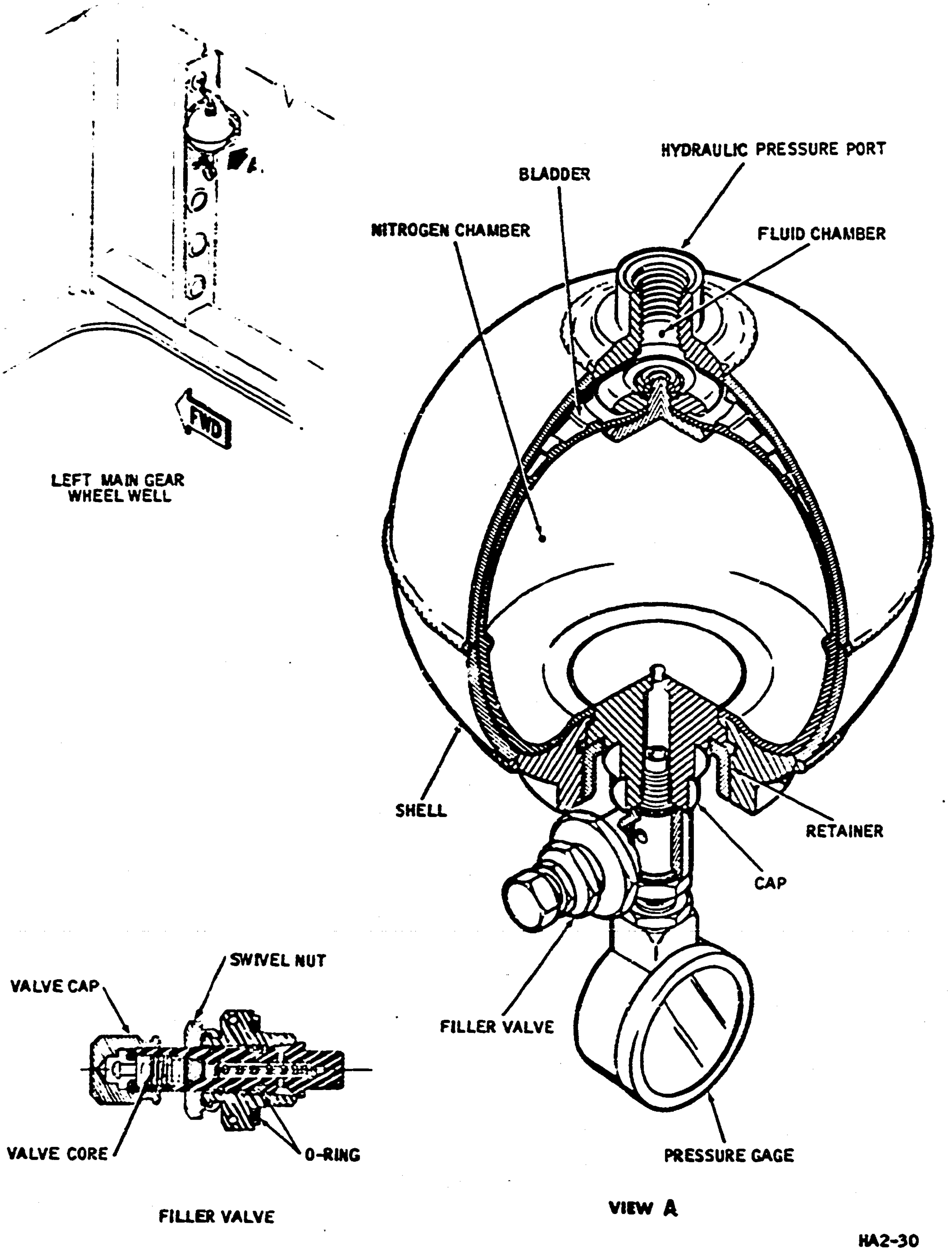
(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

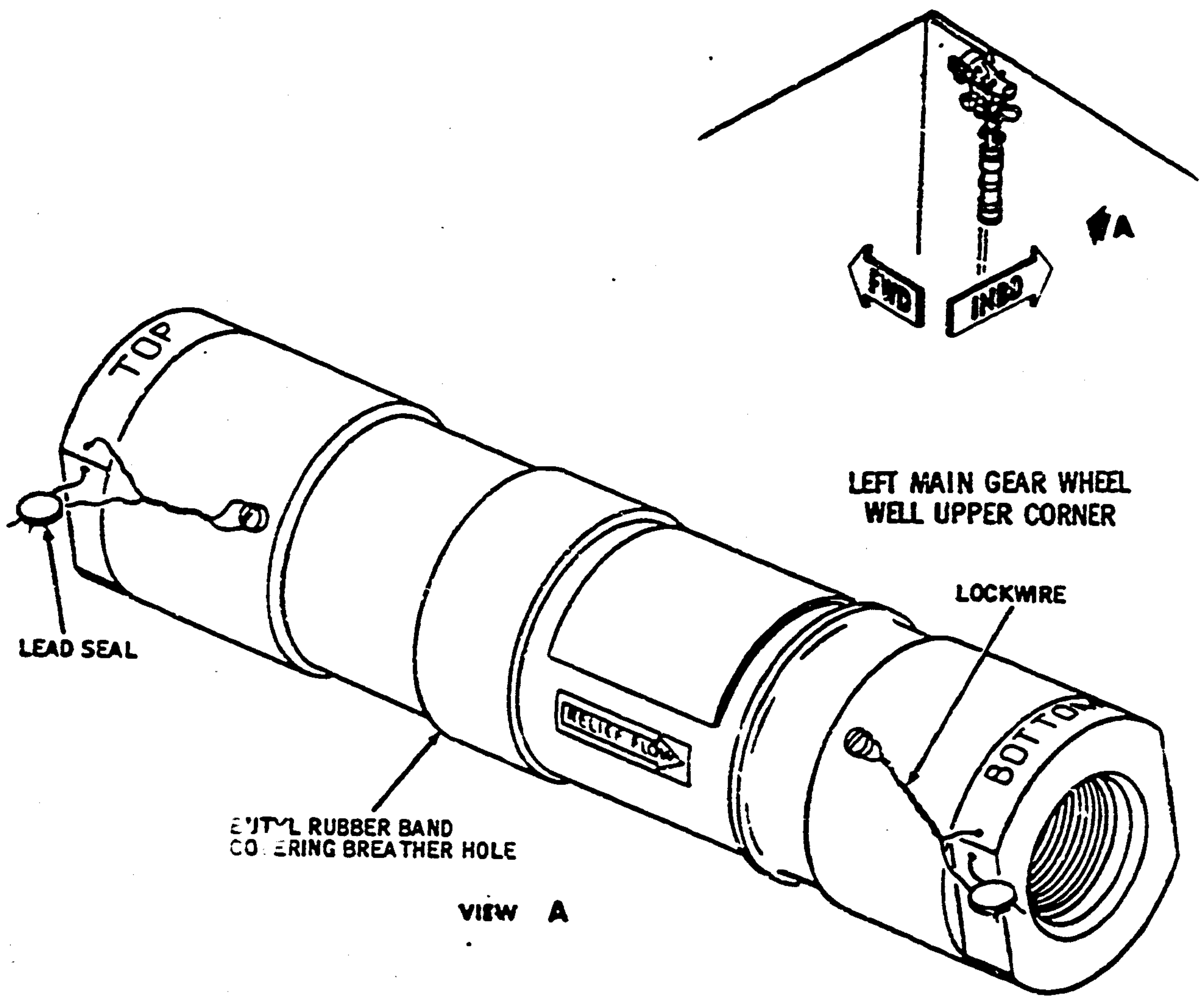
T. Hydraulic System Priority Valve (See Figure 21.)

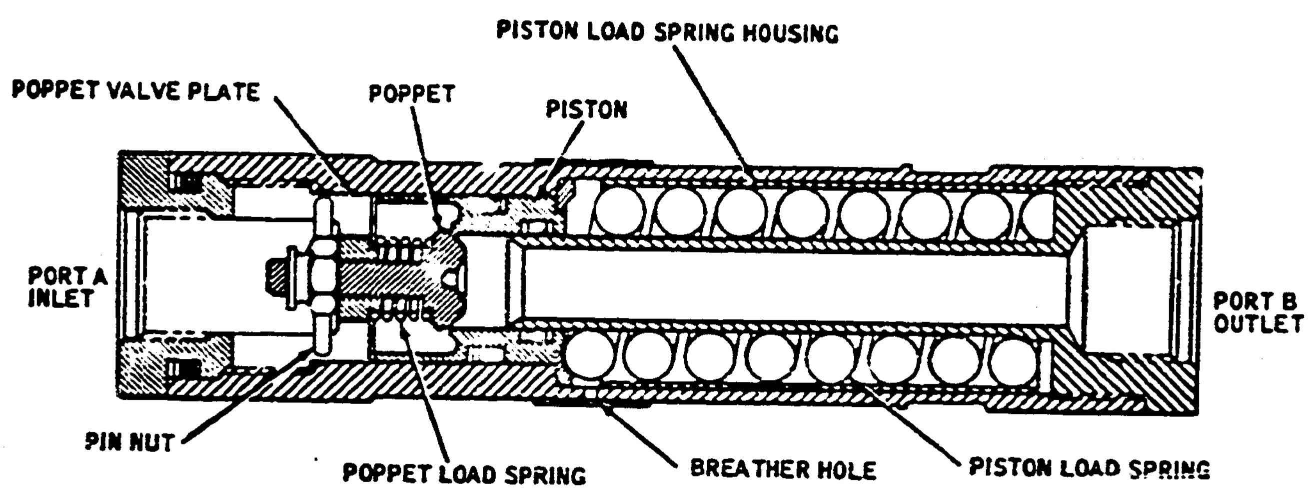
(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.



Hydraulic Power System Accumulator -- Cutaway View
Figure 20





Hydraulic System Priority Valve -- Cutaway View
Figure 21

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position.

At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

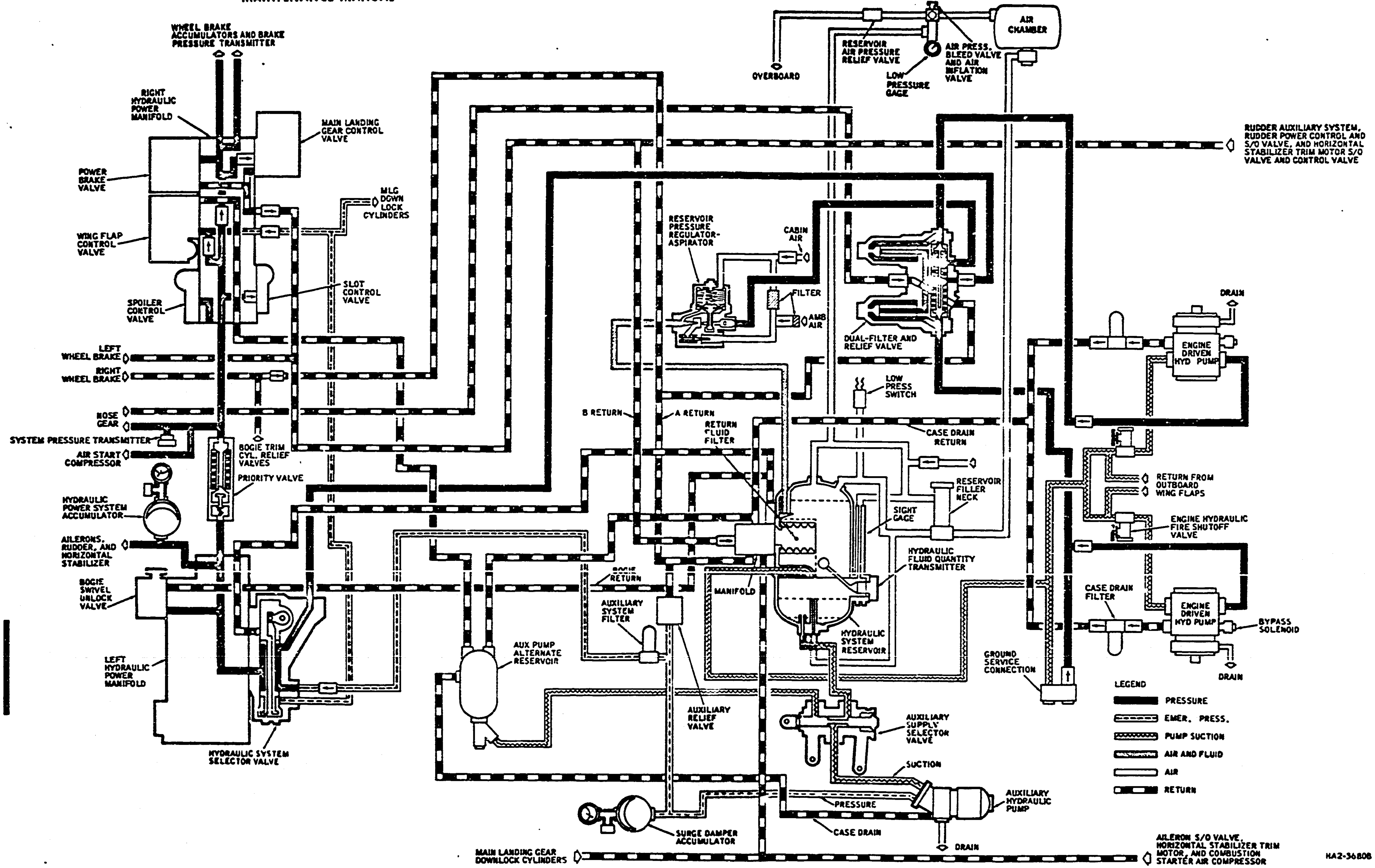
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to



Hydraulic Power System -- Schematic Diagram
Figure 1

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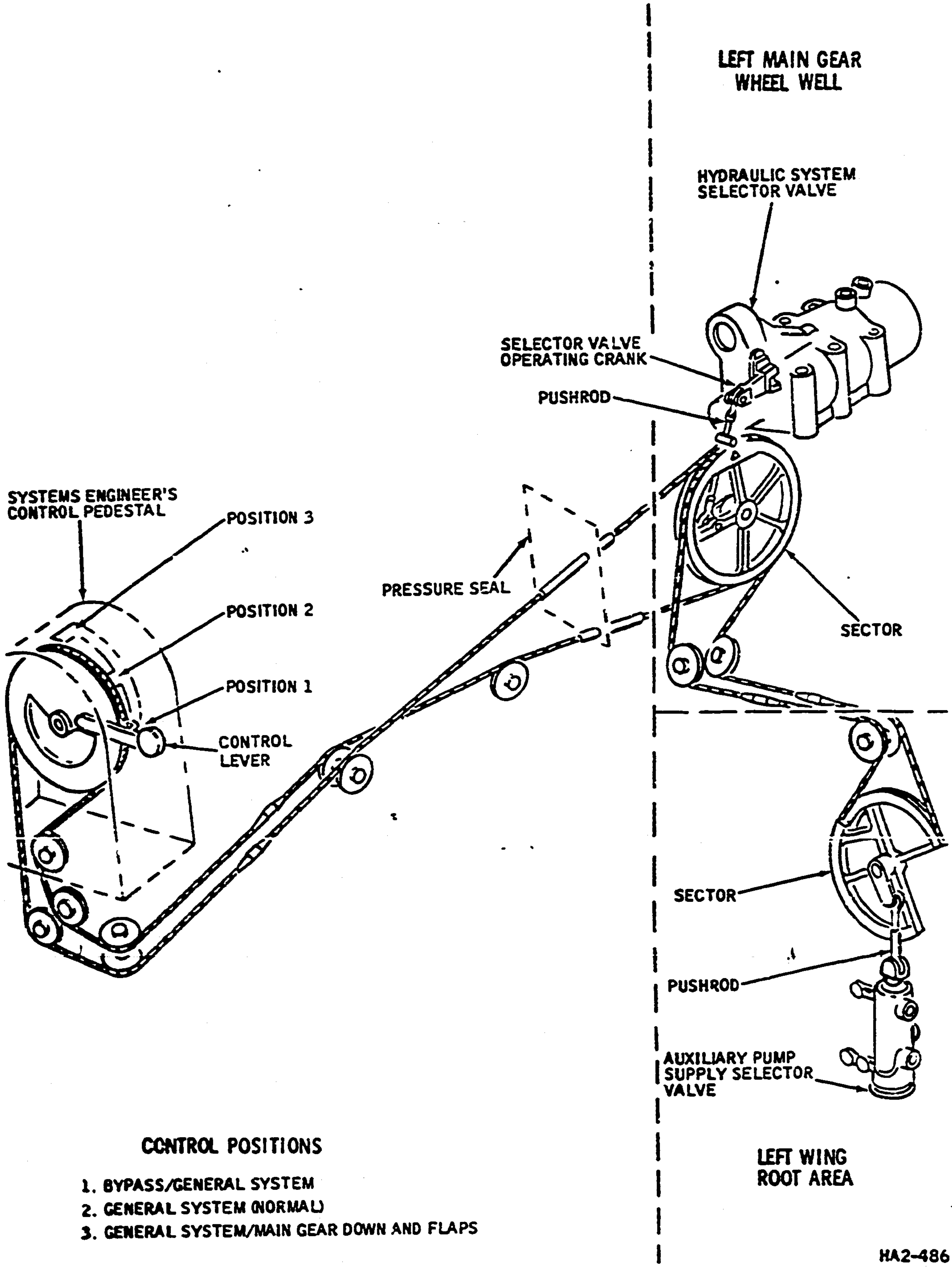


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm and the relief valve maintain 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid from the left manifold to the bogie return port of the reservoir. All

return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

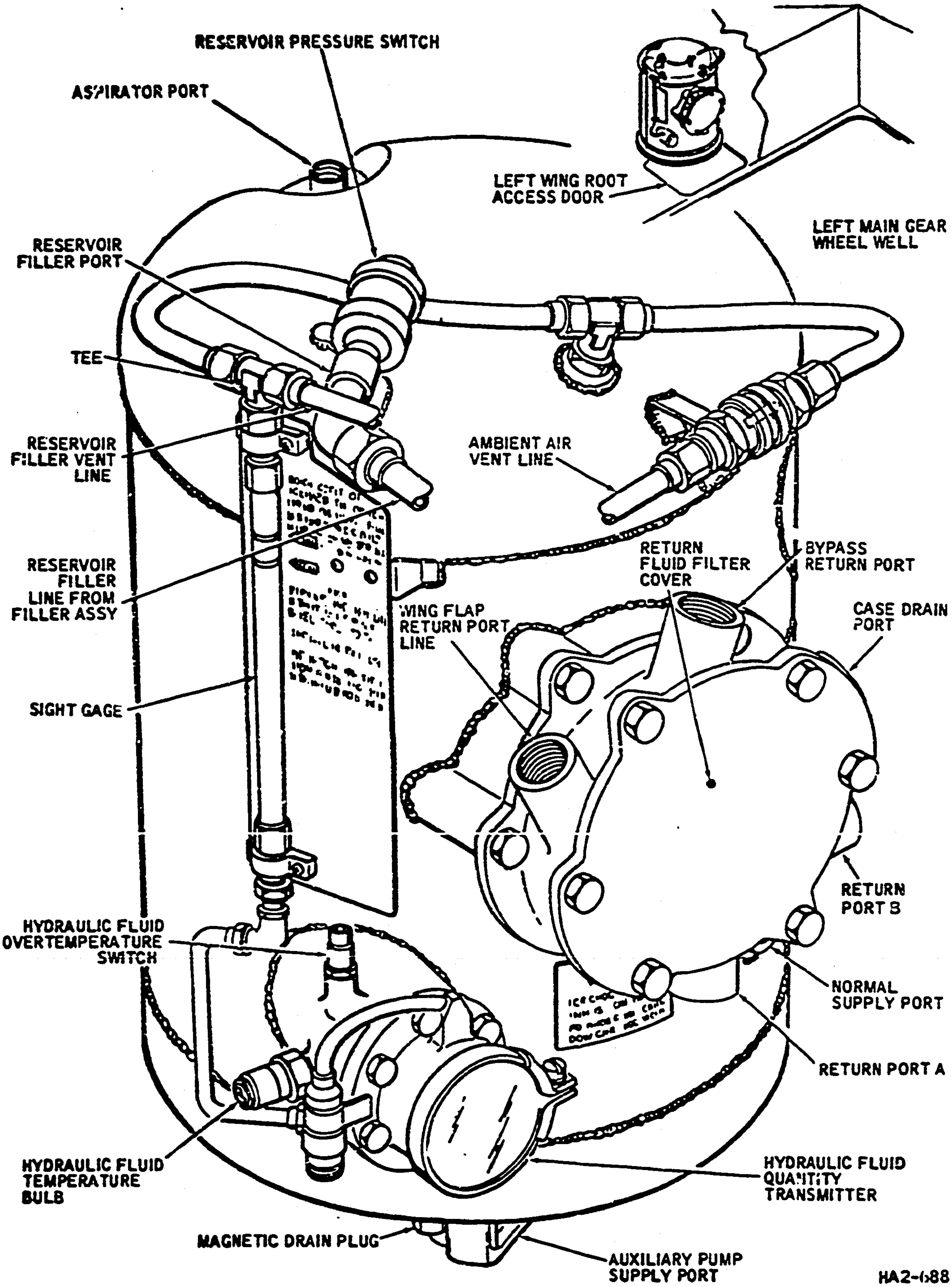
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

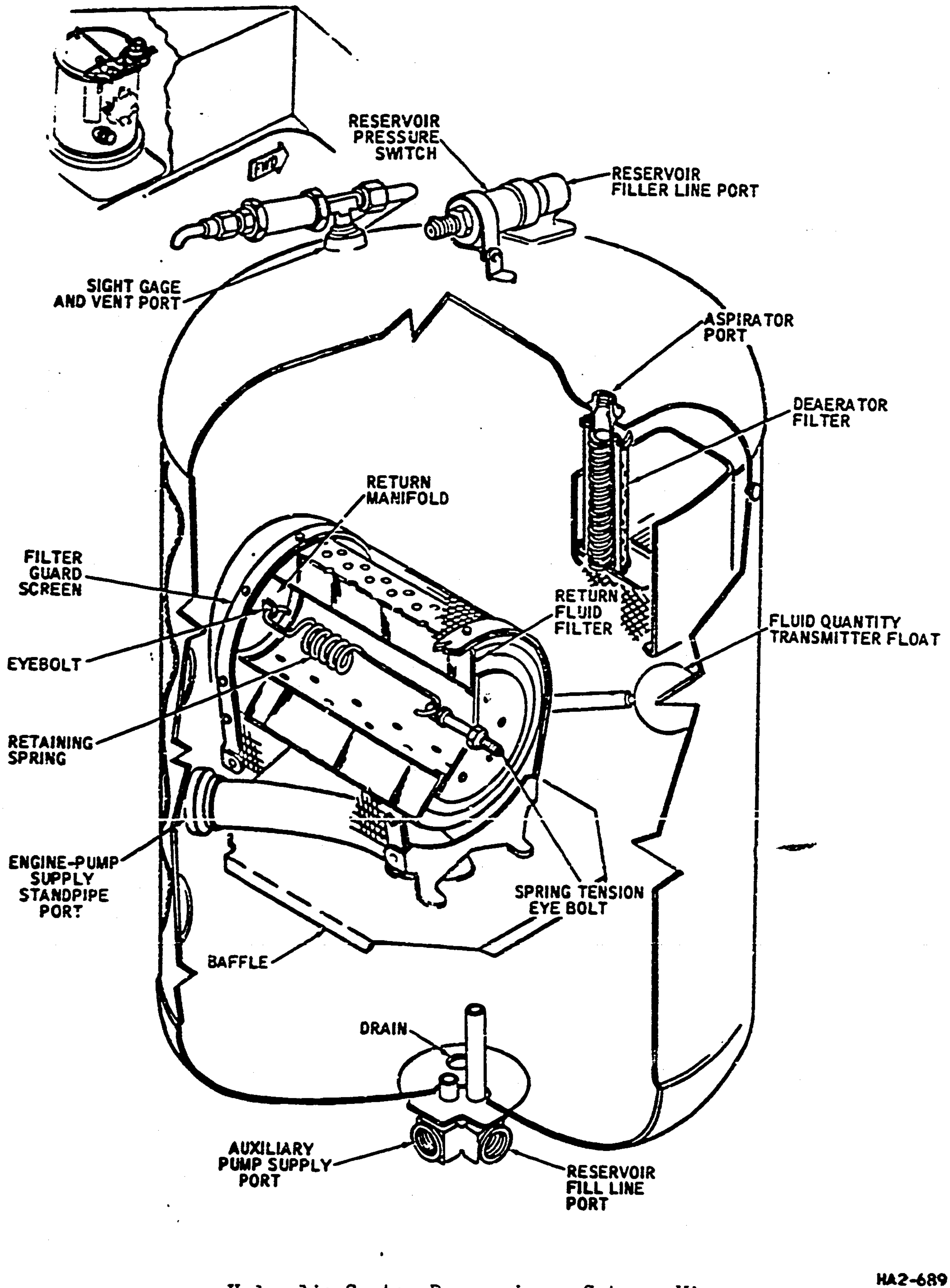
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to between 30 and 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

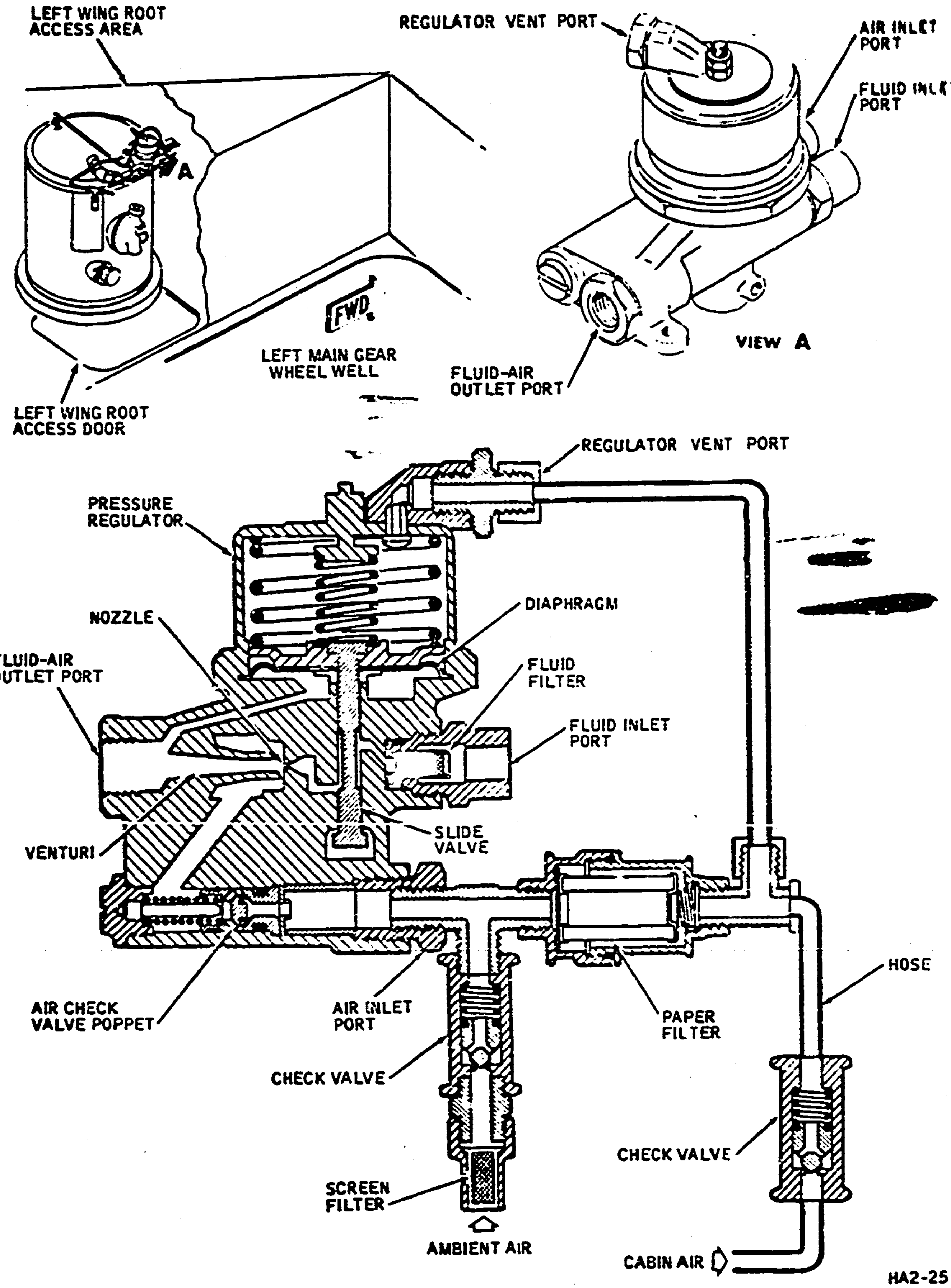
(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently stamped inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. When air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

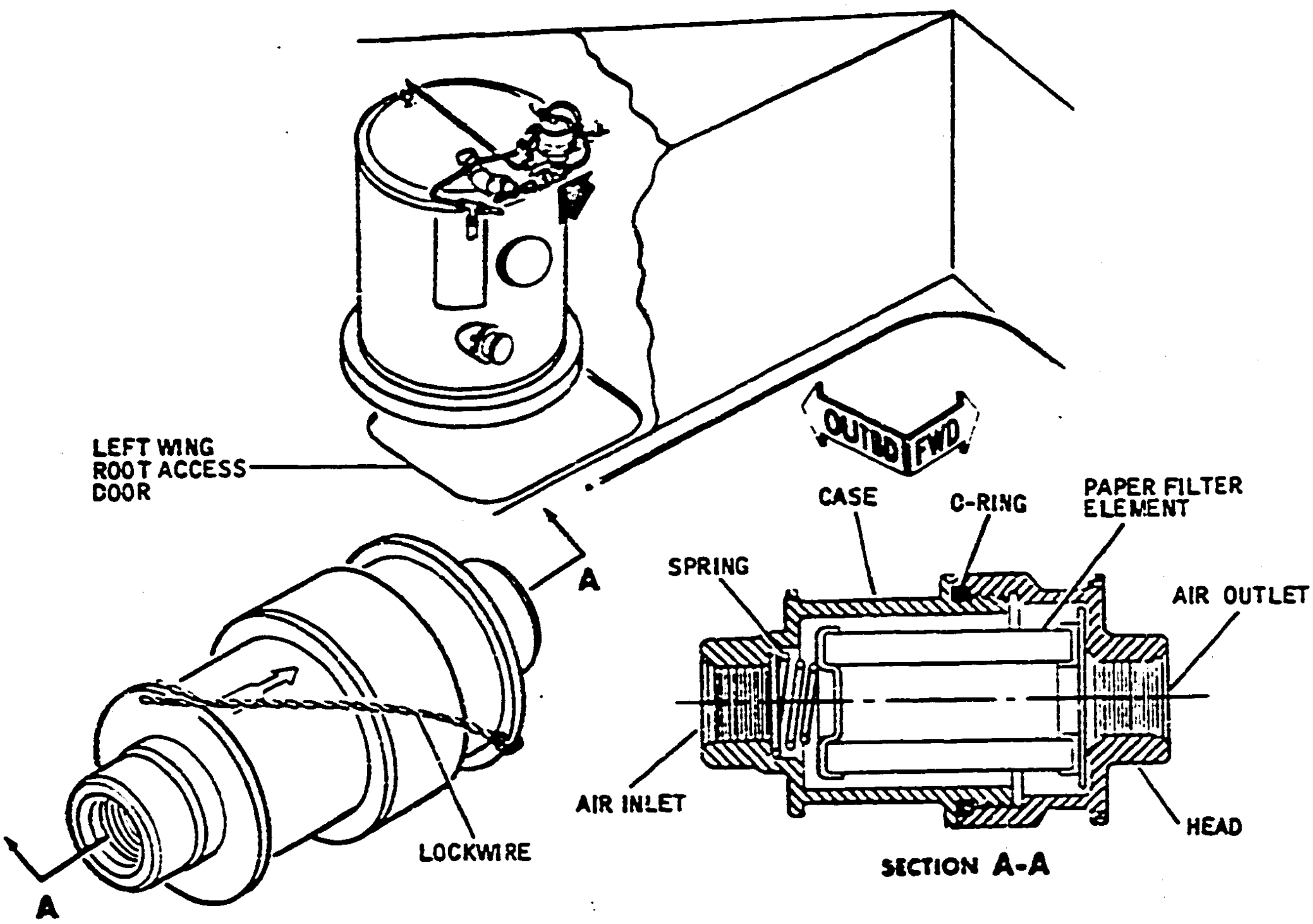
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

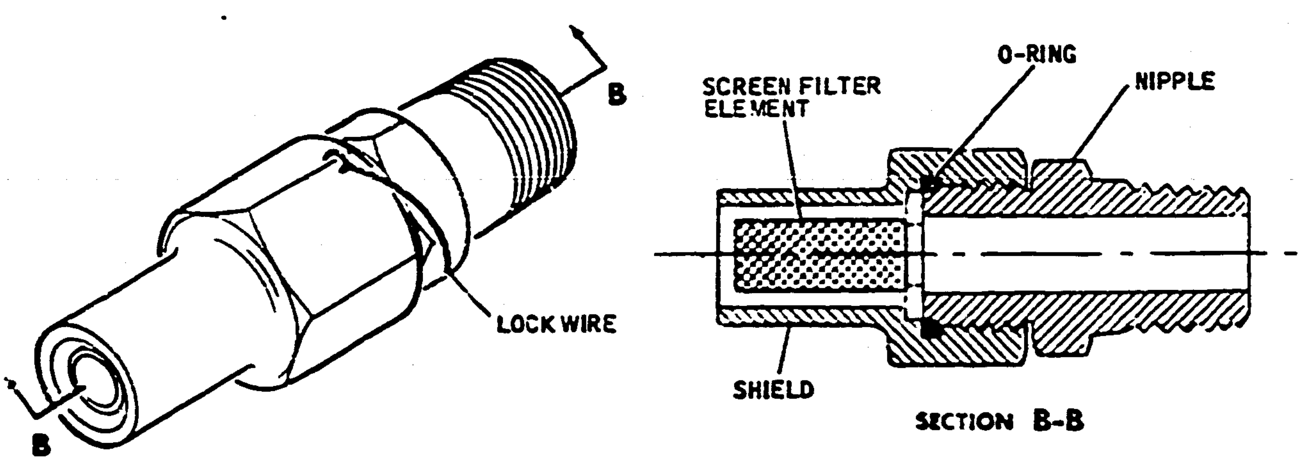
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.



PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

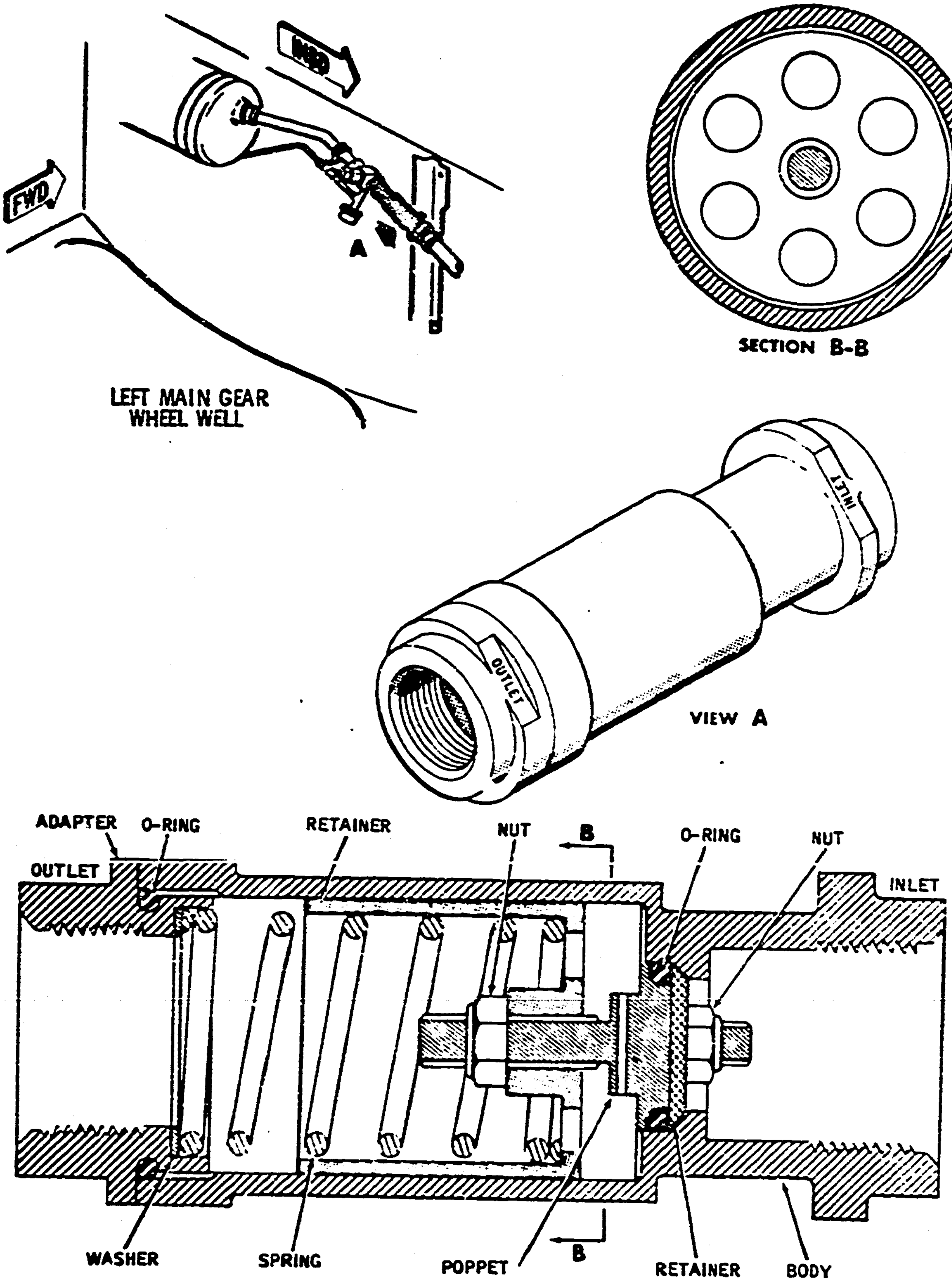
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

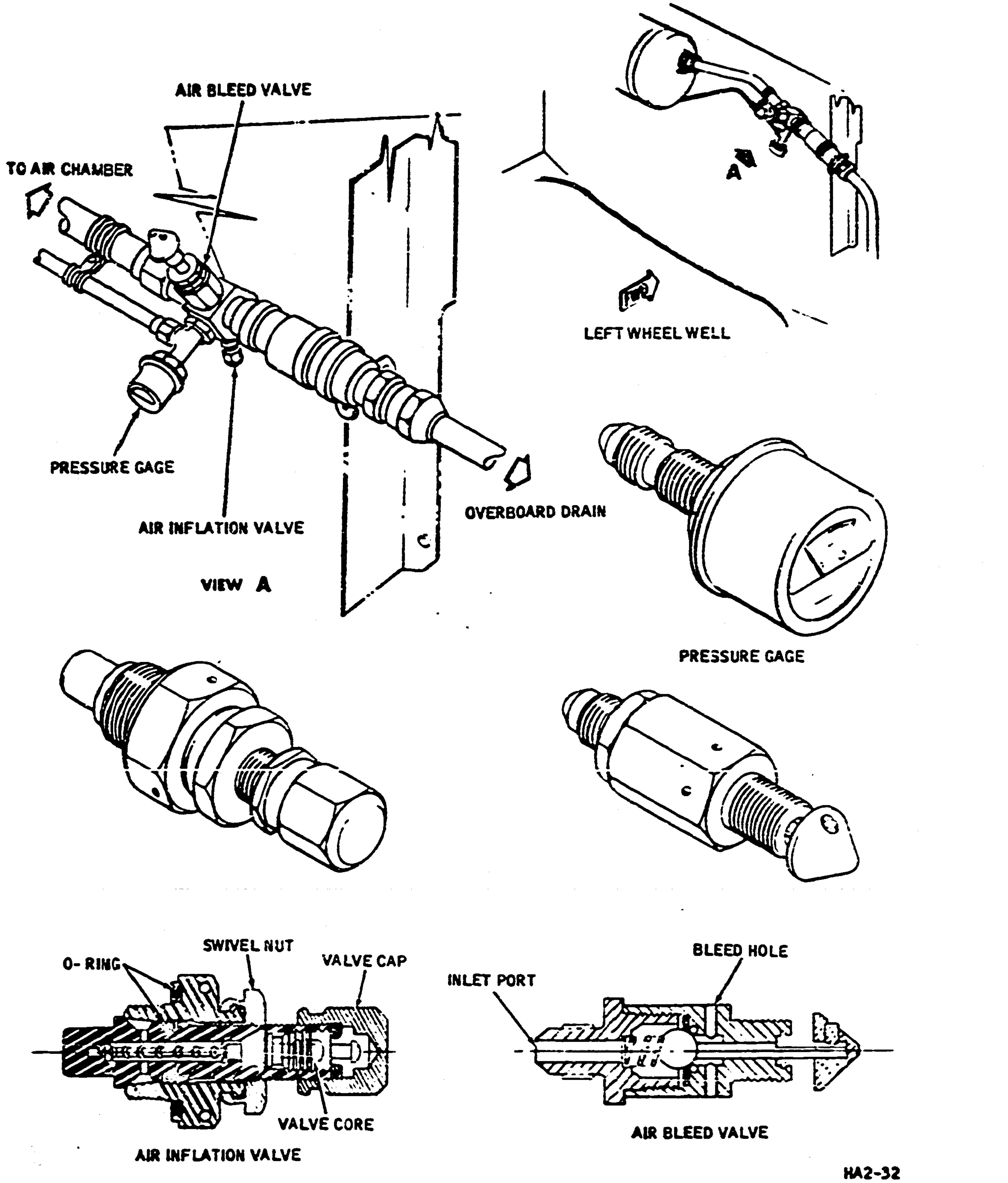
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is

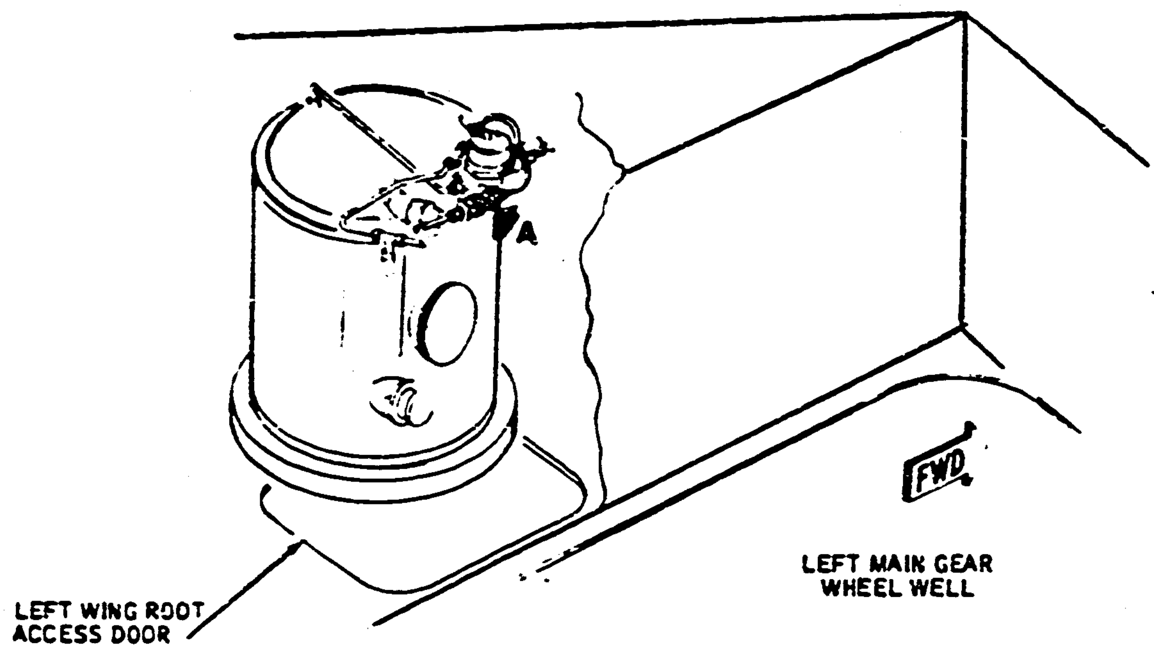


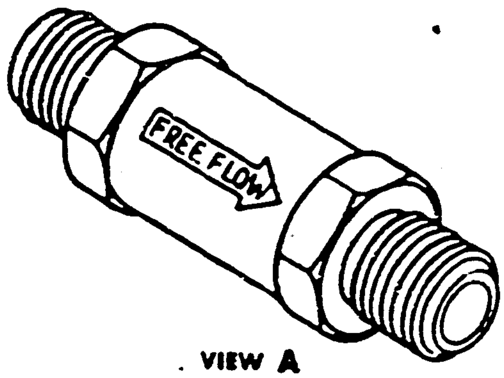
HA2-17

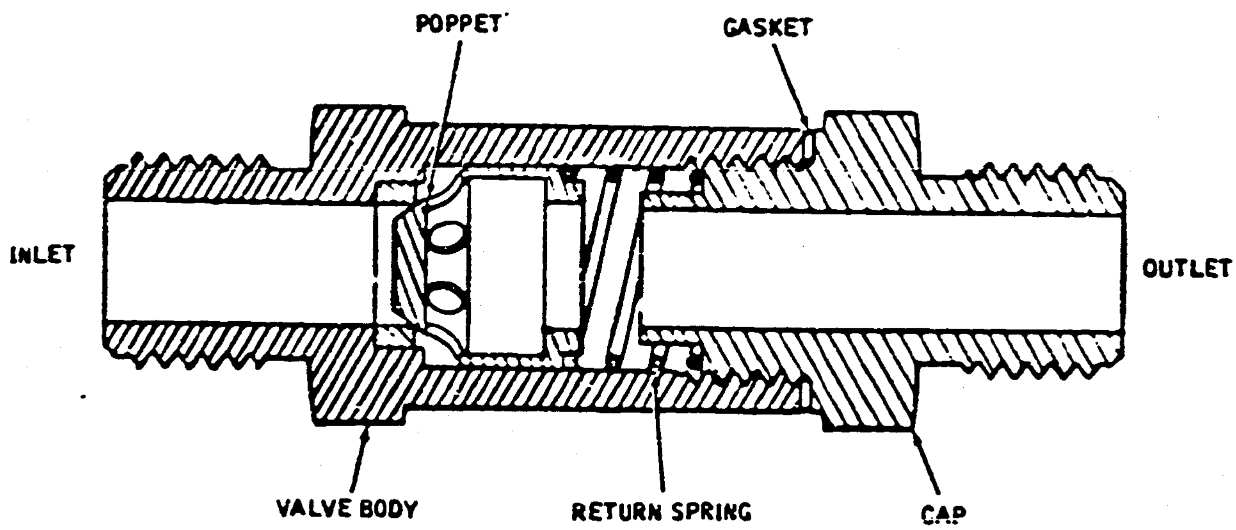
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8







HA2-33

Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

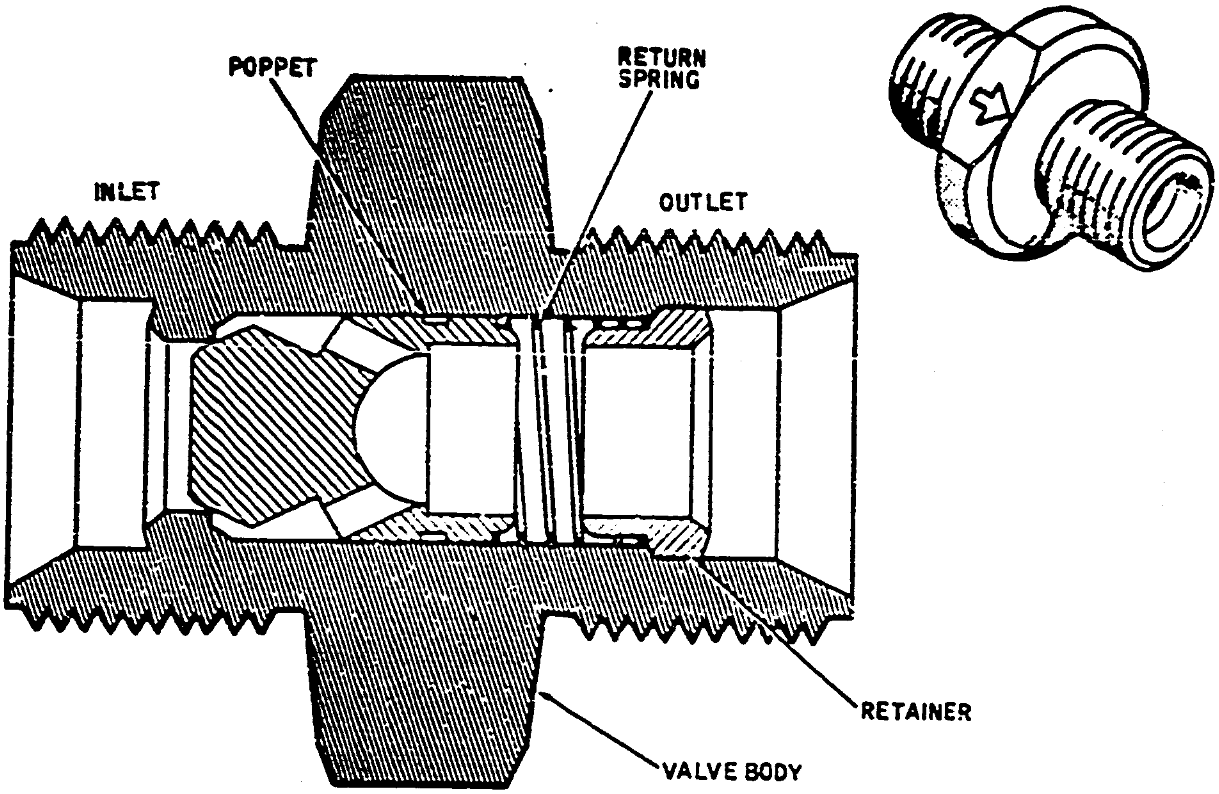
J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

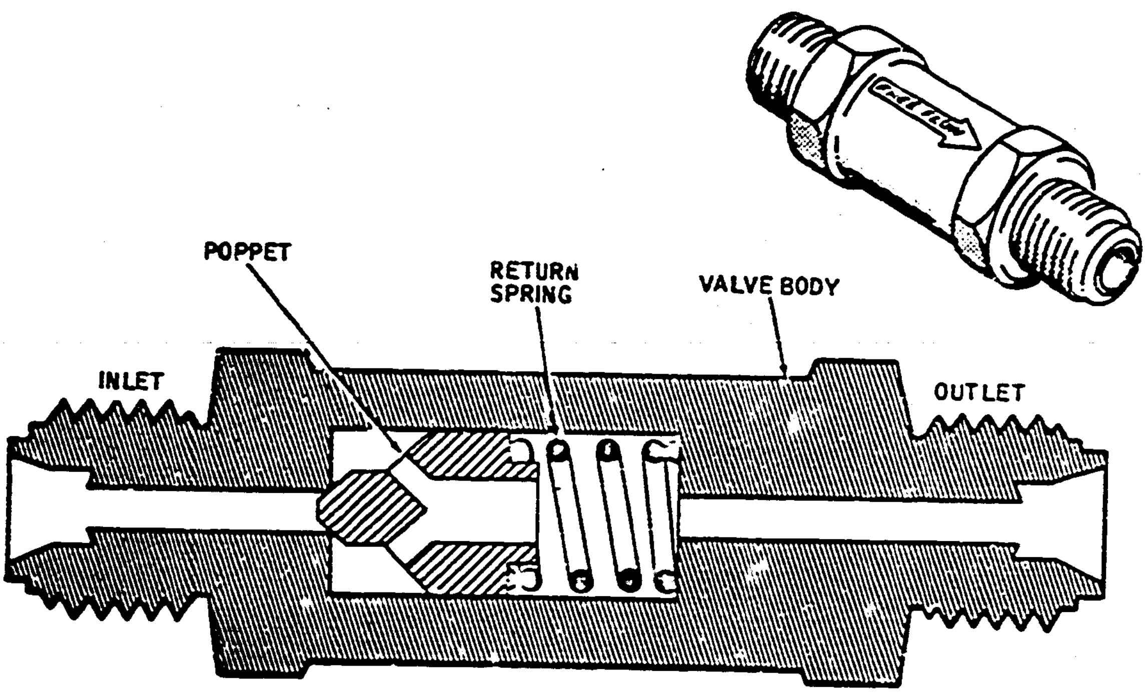
(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes



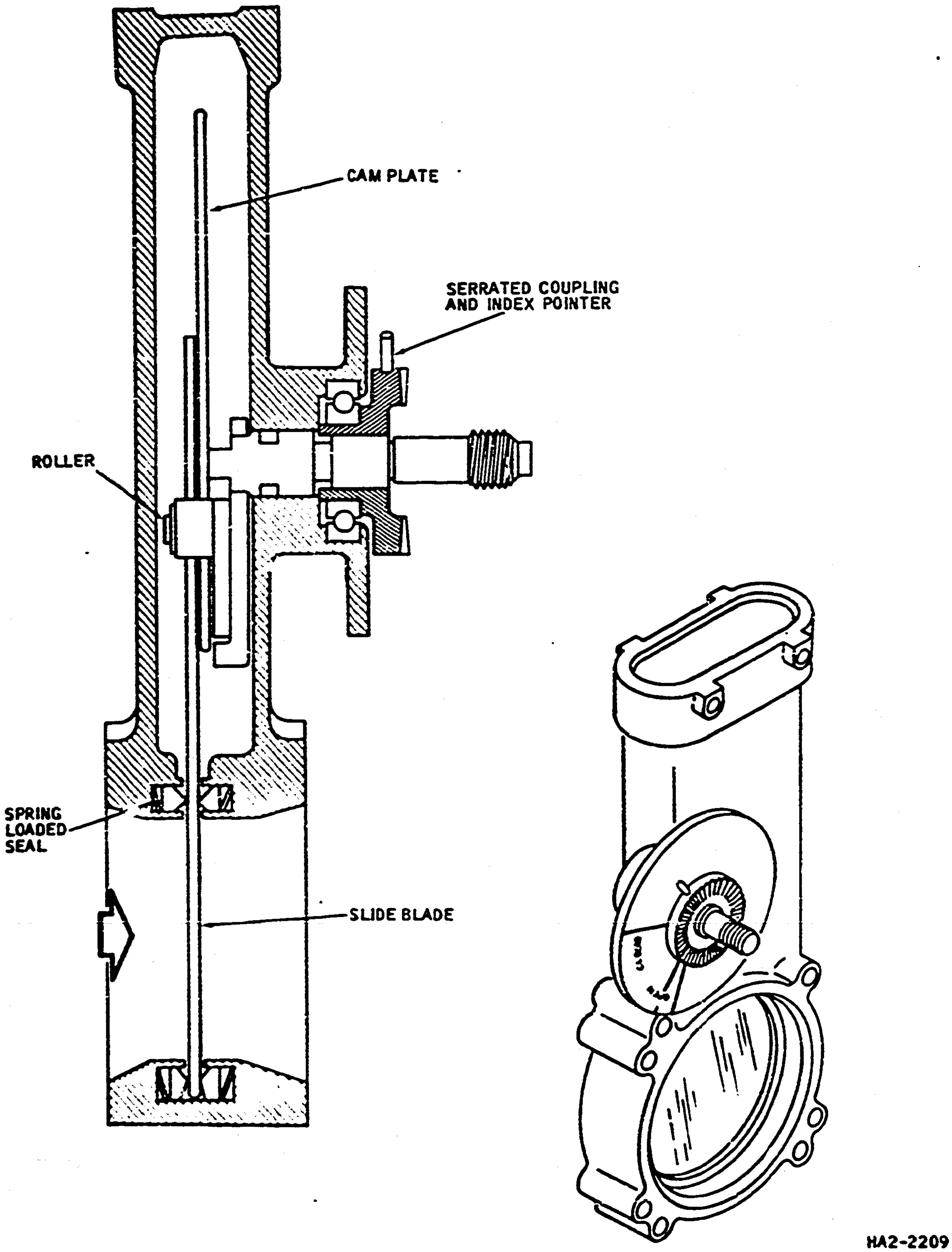
MINIATURE CHECK VALVE



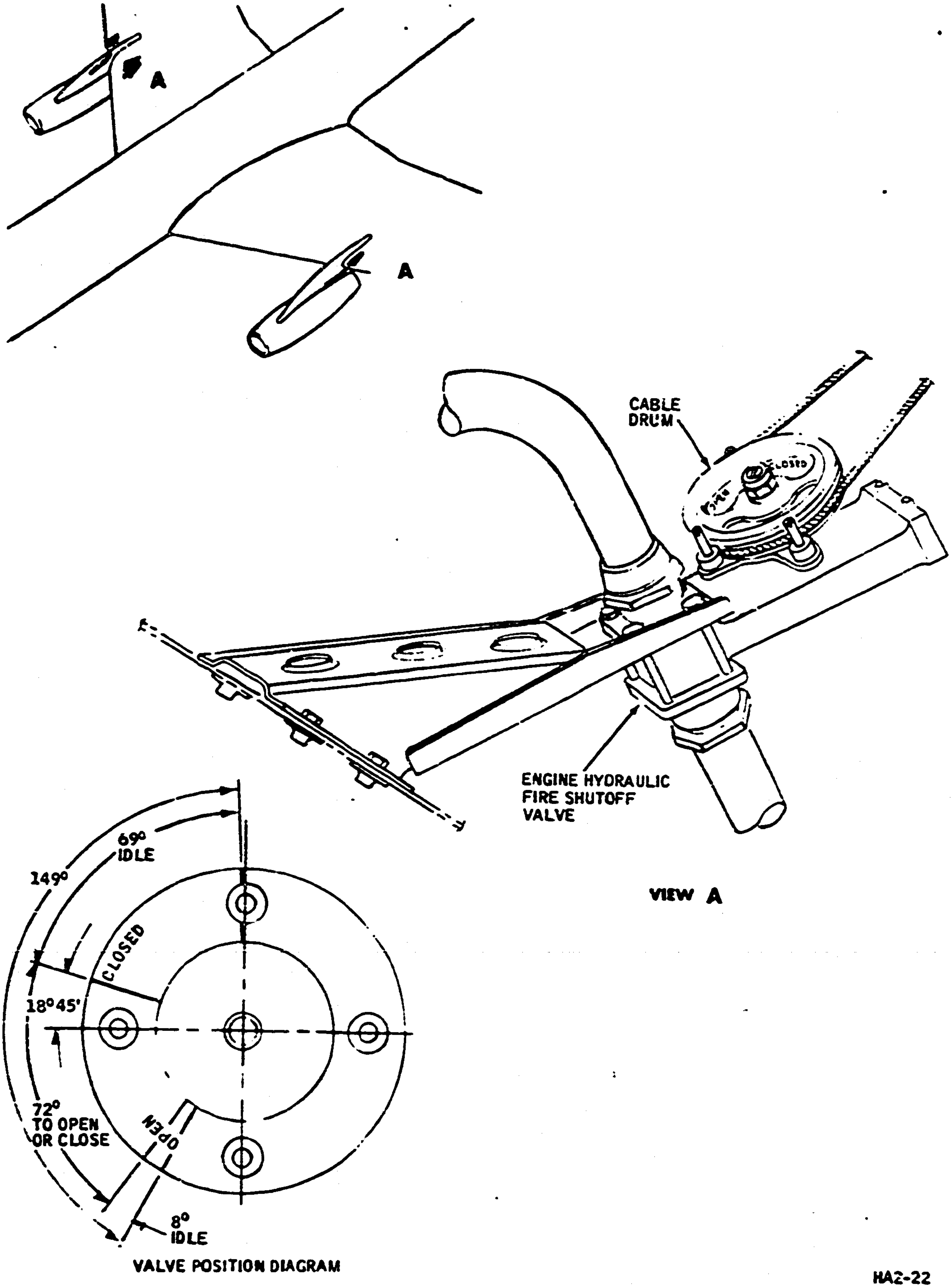
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

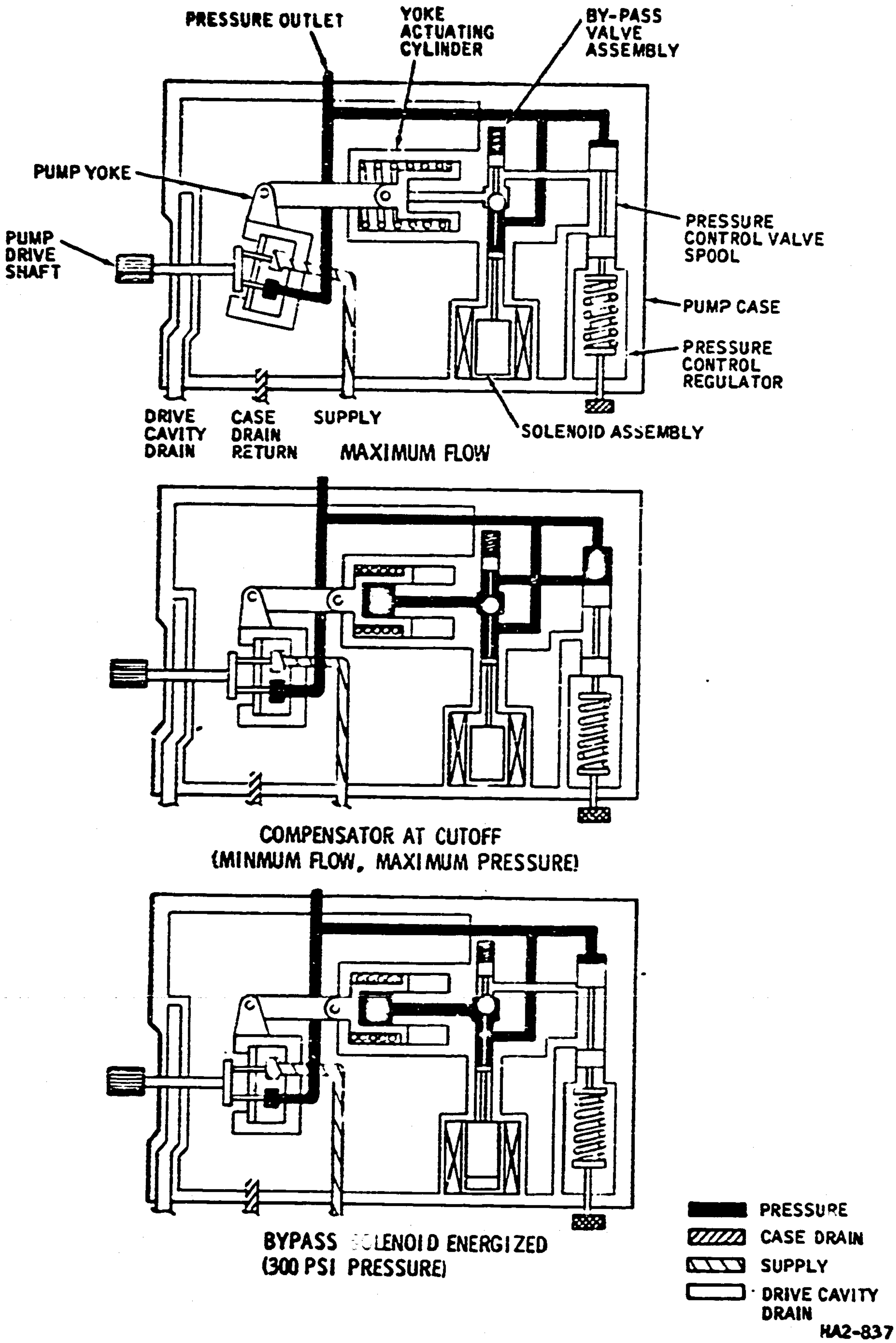
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow to fluid.

The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port at the reservoir.



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

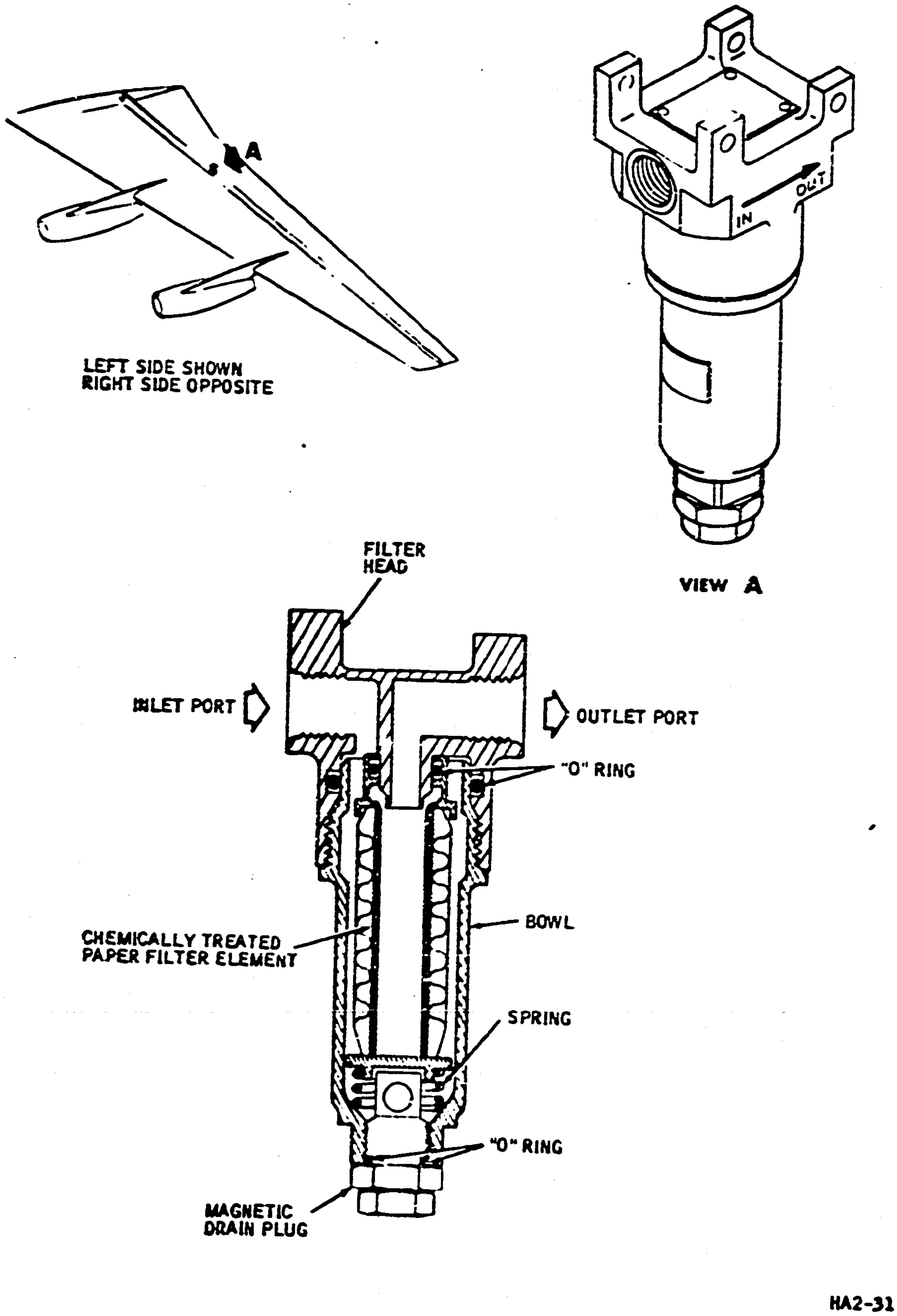
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

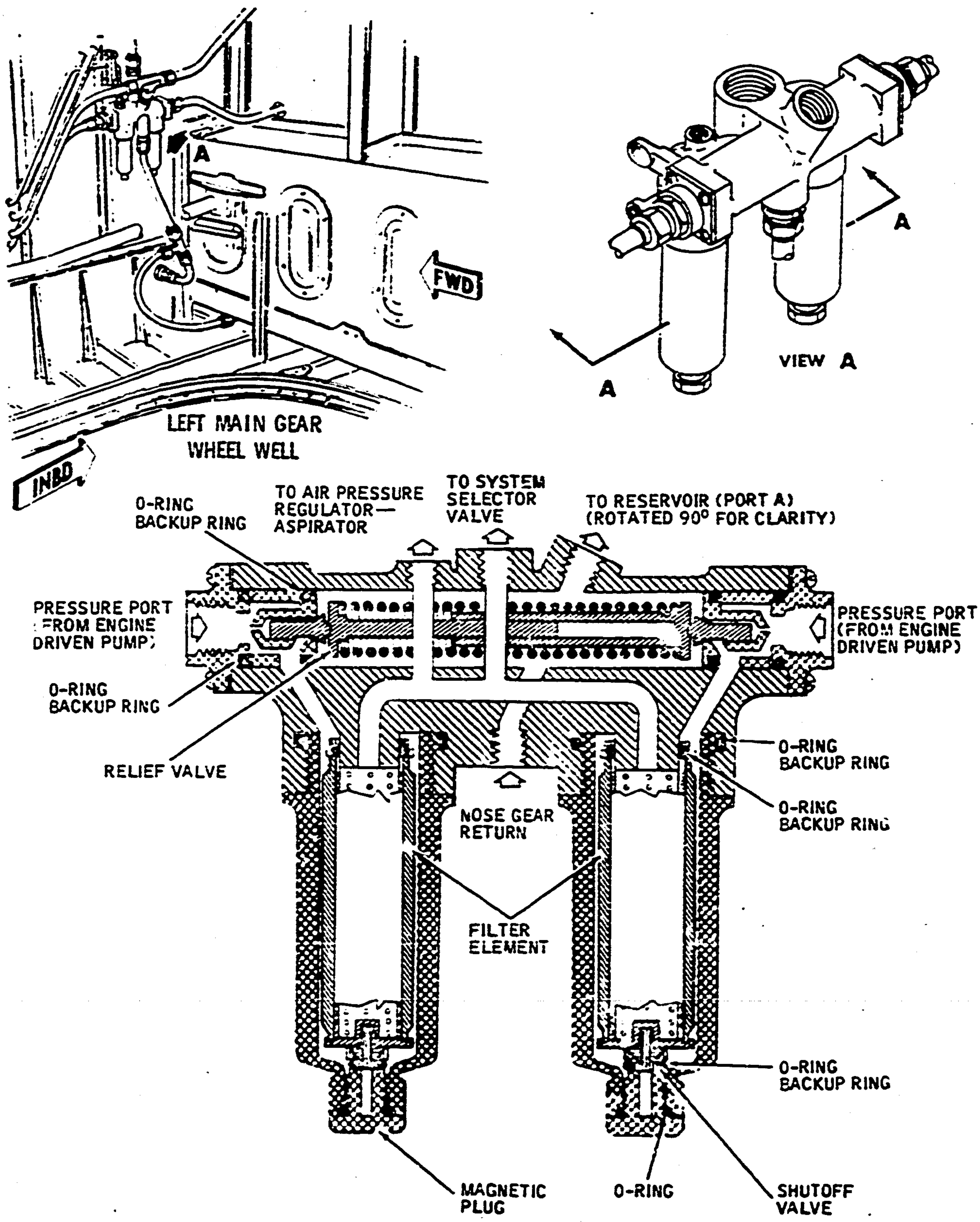
(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



SECTION A-A

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Dual Filter and Relief Valve -- Cutaway View
Figure 15

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

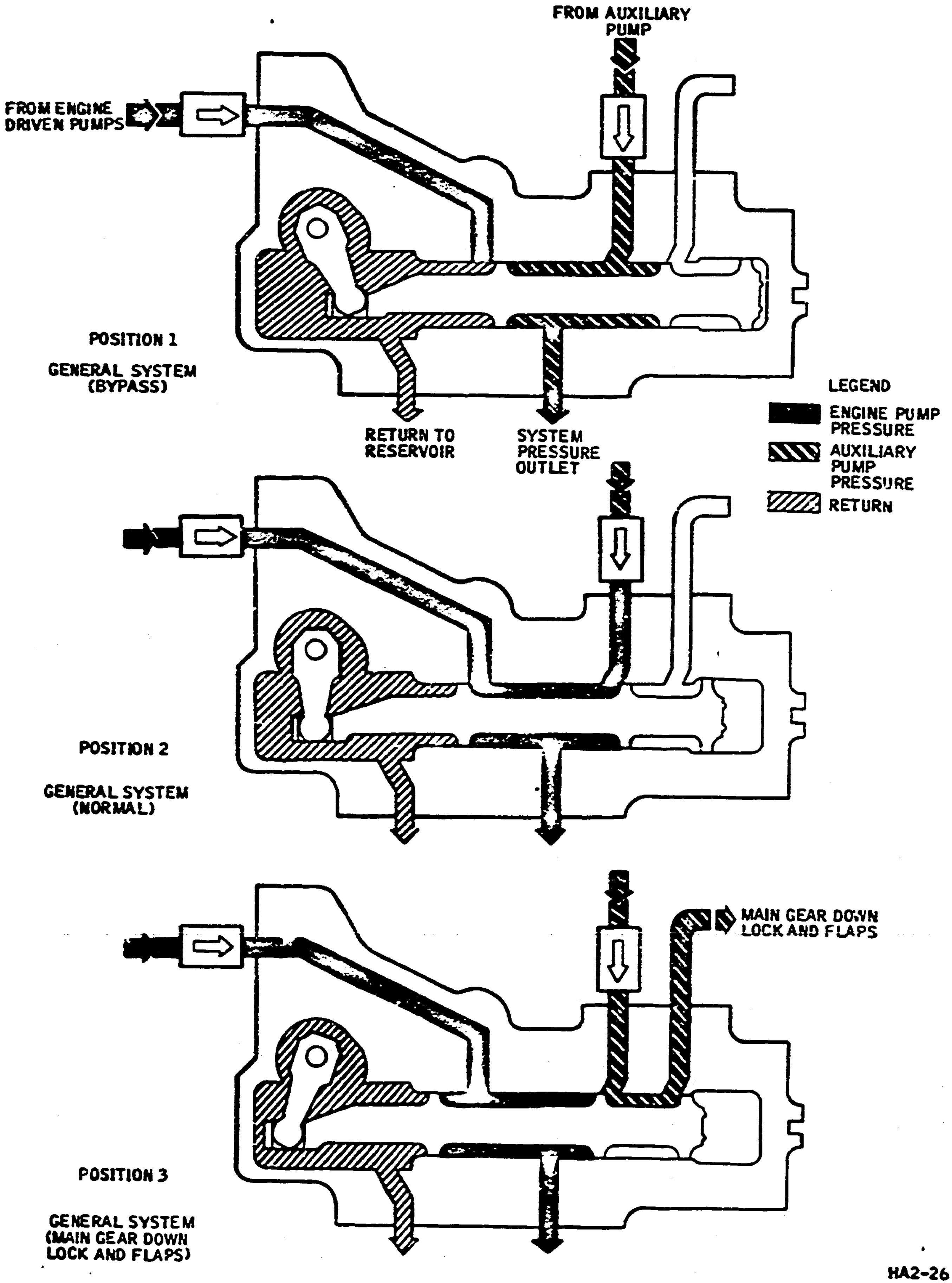
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

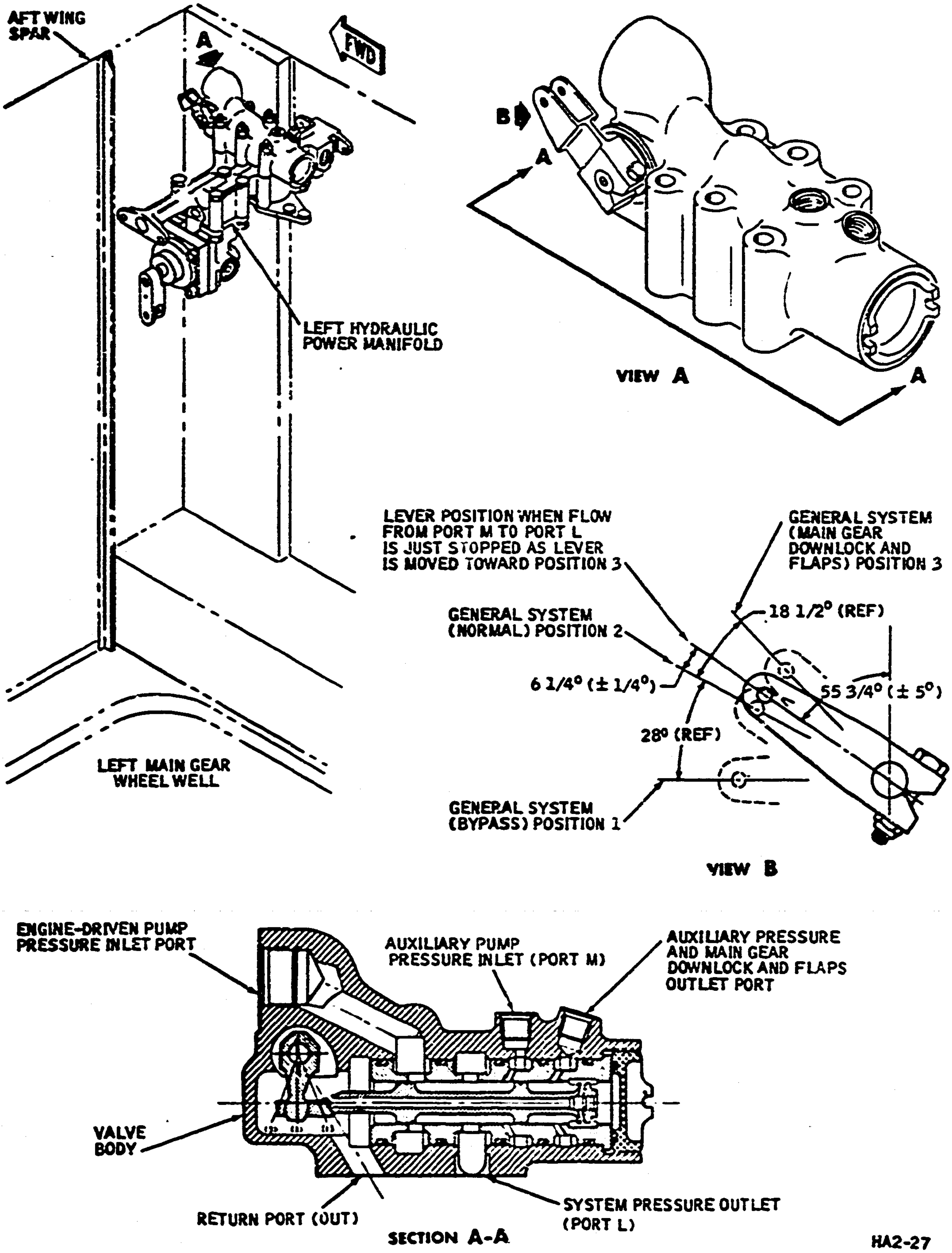
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

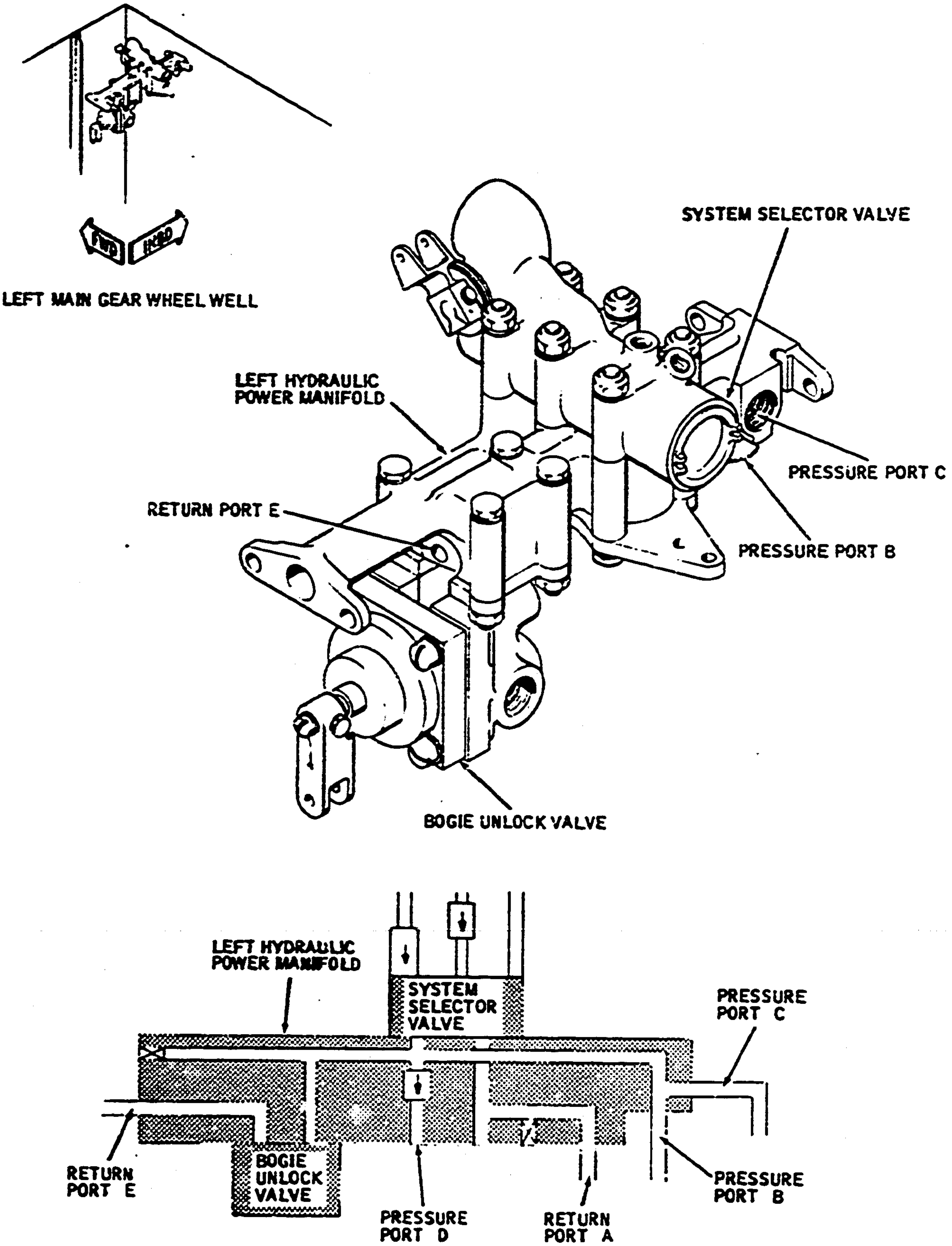
(2) Three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold pressure



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17



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Left Hydraulic Power Manifold -- Schematic
Figure 18

outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

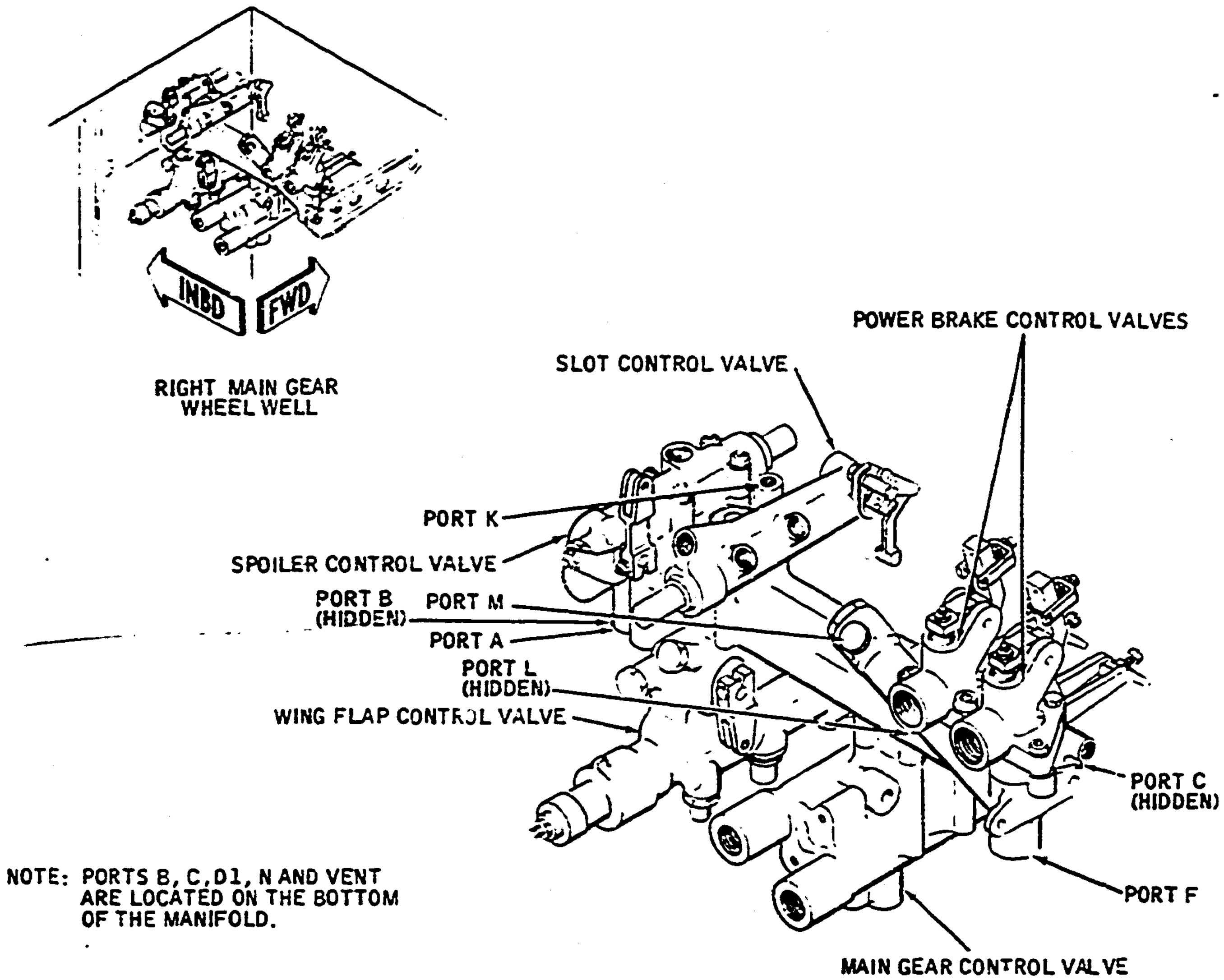
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

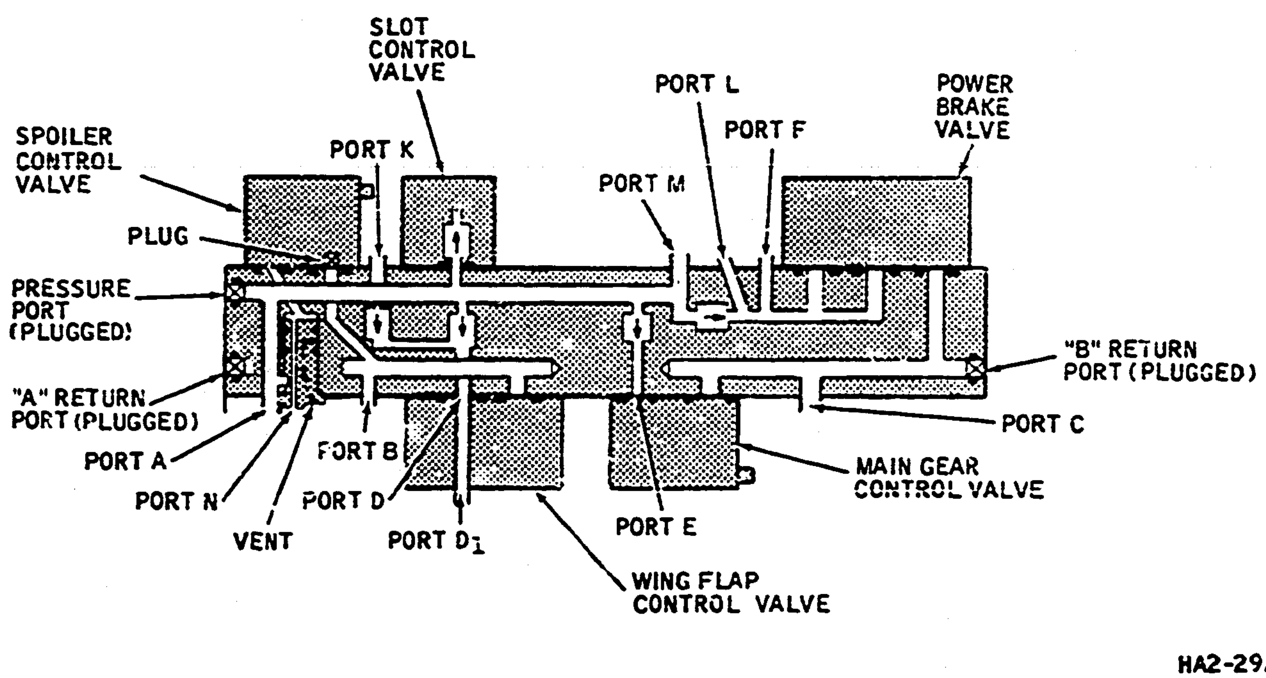
(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Hydraulic Manifold Return Check Valves (See Figure 10.)

(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.





Right Hydraulic Power Manifold -- Schematic
Figure 19

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

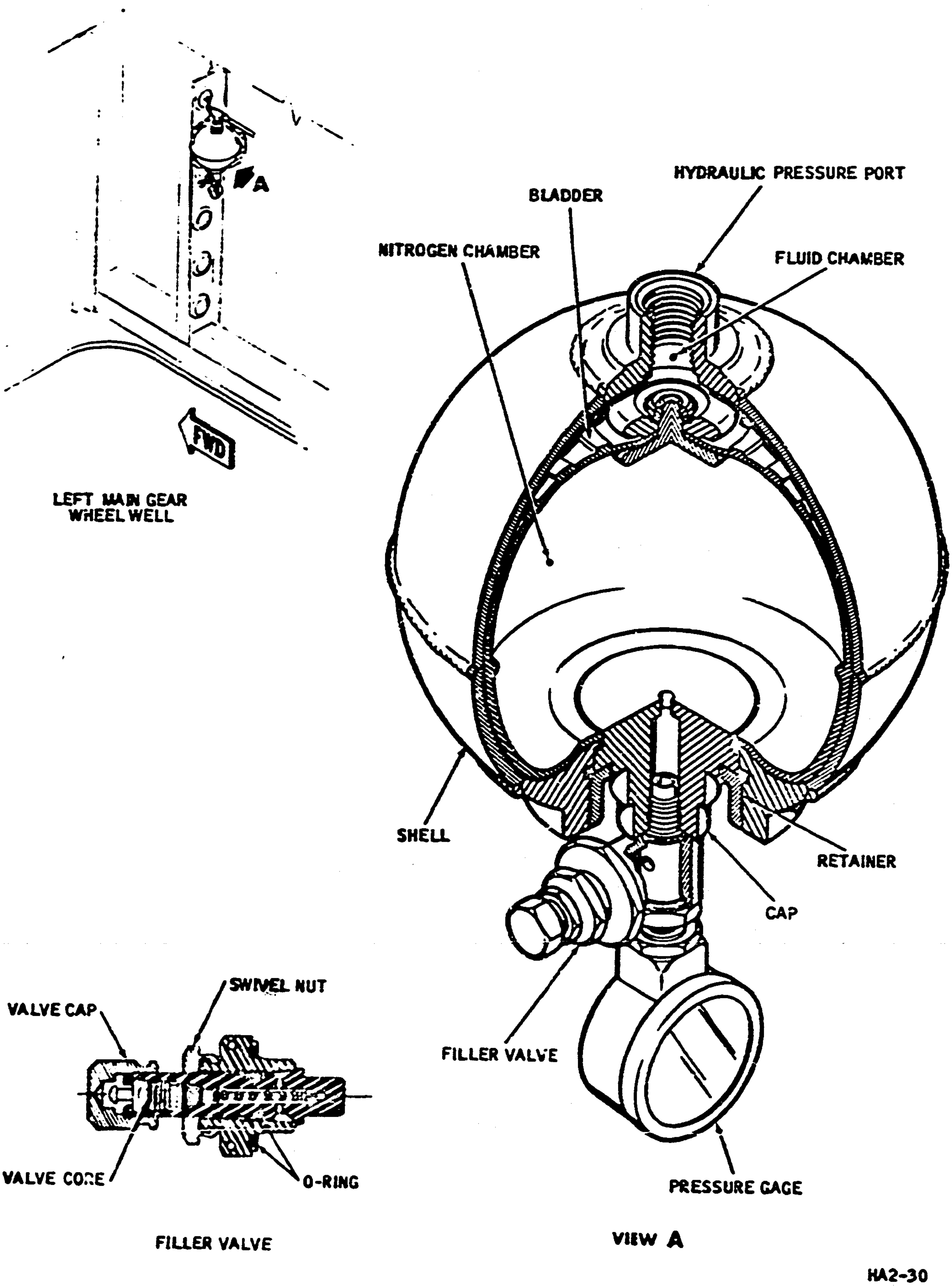
(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smoothes out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

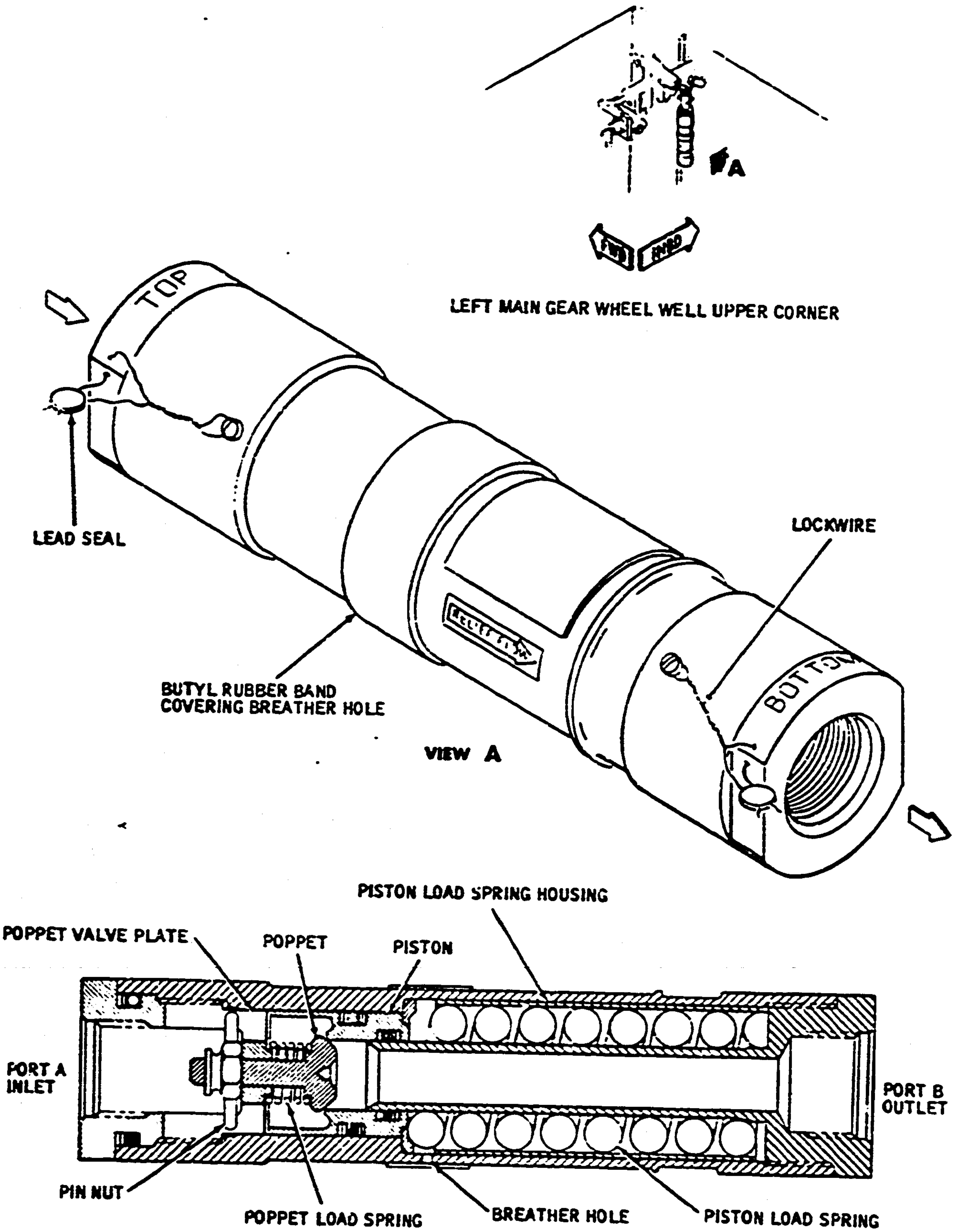
T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.



Hydraulic Power System Accumulator -- Cutaway View
Figure 20



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Hydraulic System Priority Valve -- Cutaway View
Figure 21

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position.

At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

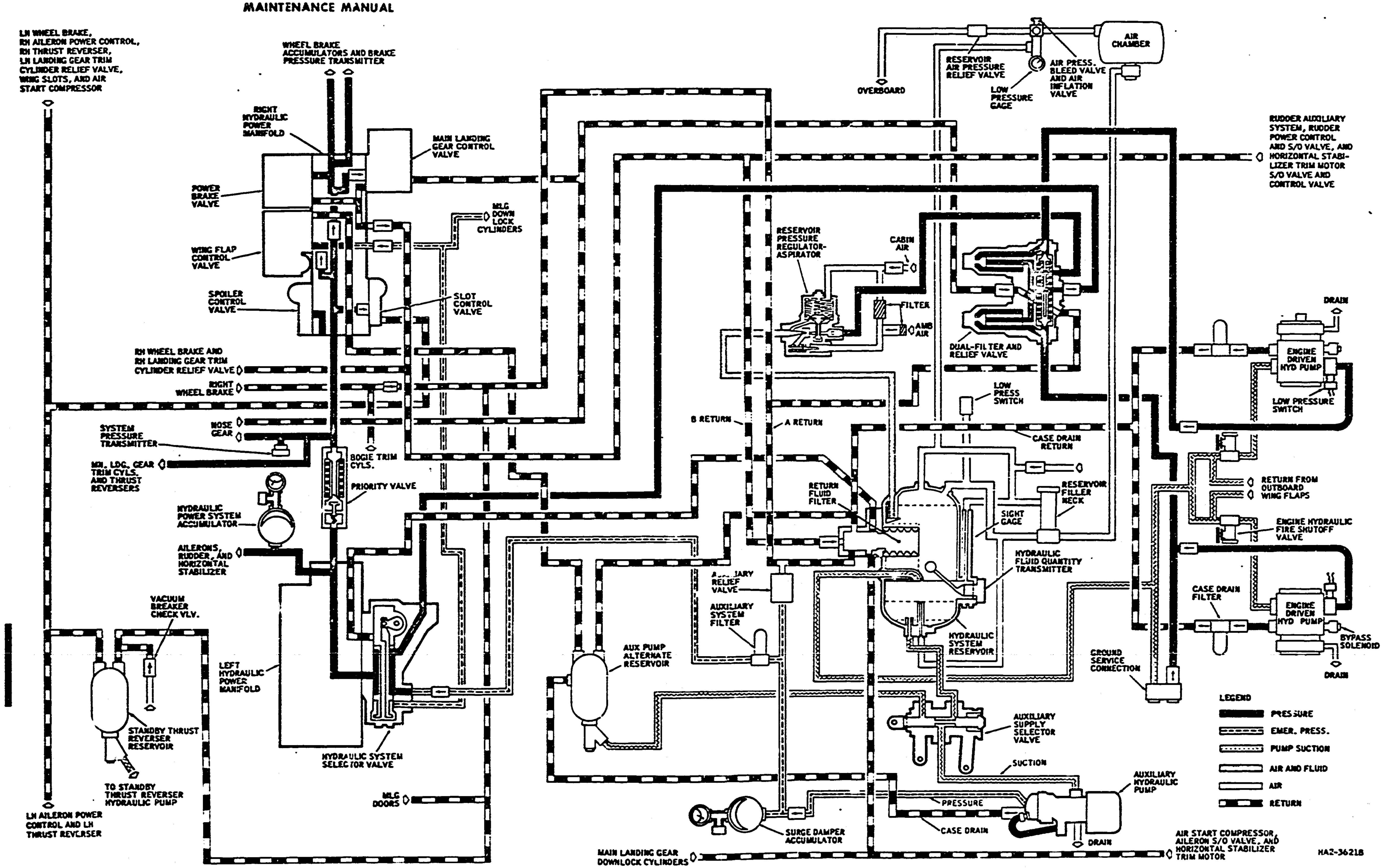
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

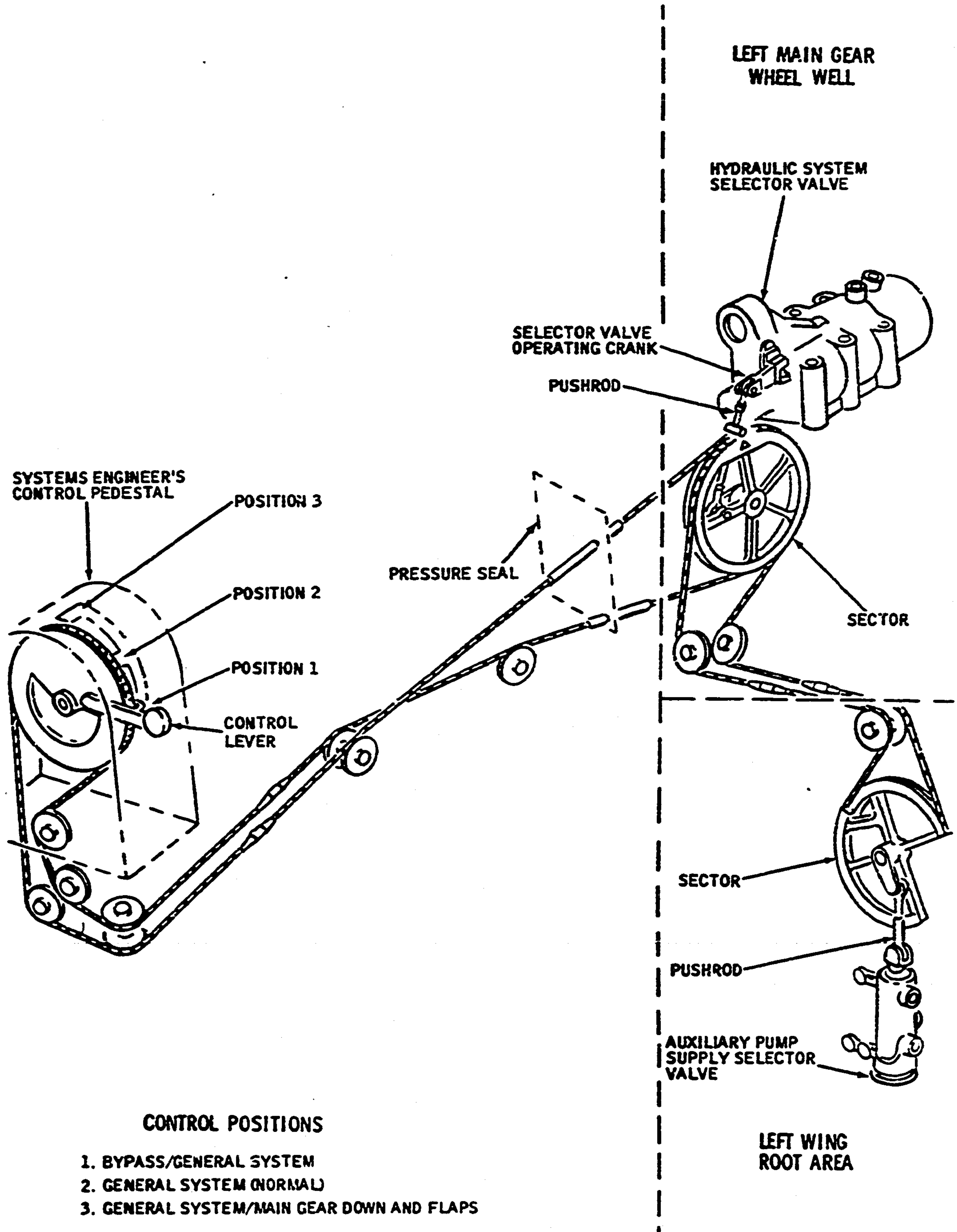
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram
Figure 1



Hydraulic System Selector and Auxiliary Pump Supply Selector Valves --
Mechanical Control Schematic
Figure 2

back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) lot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

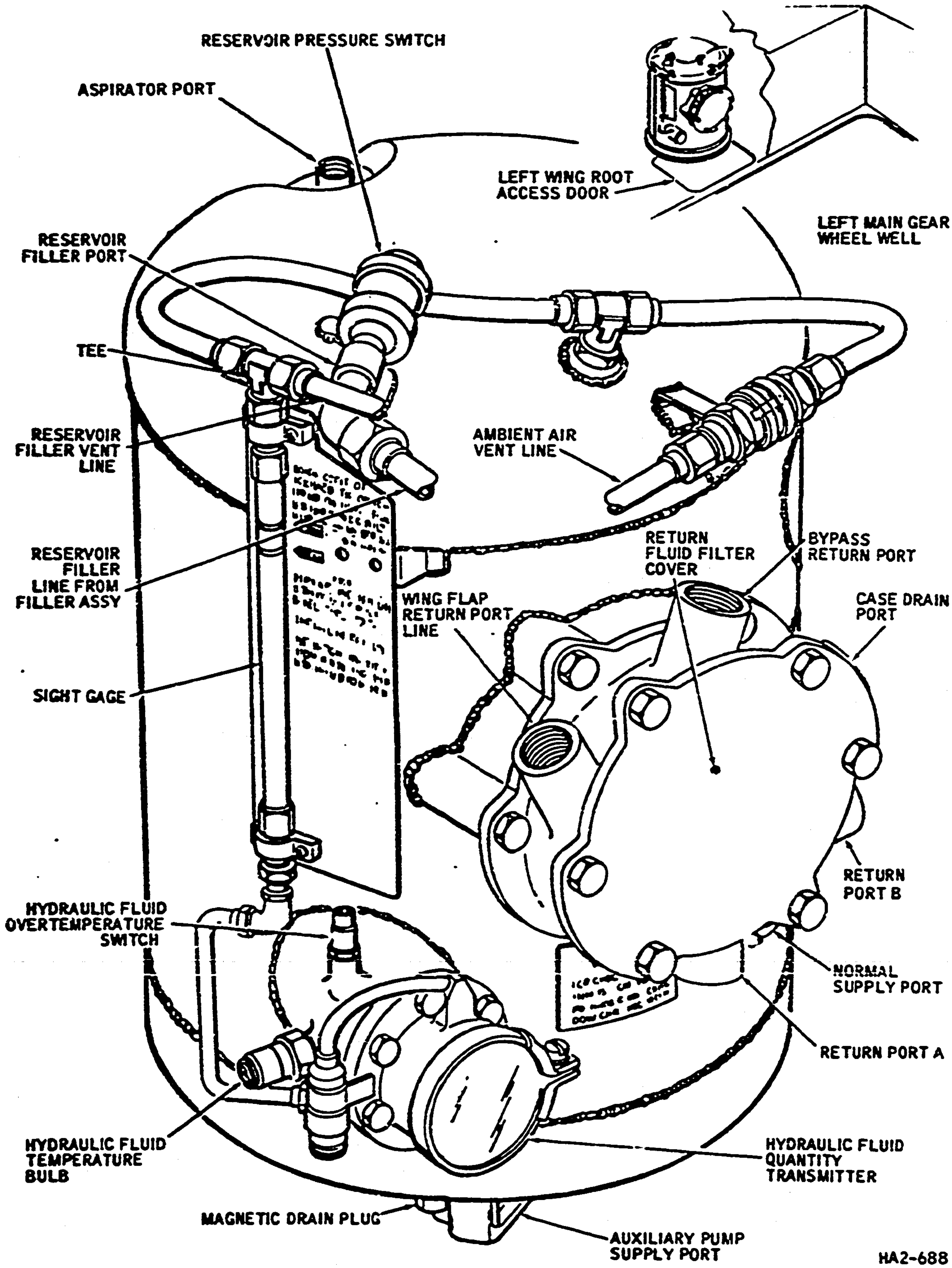
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

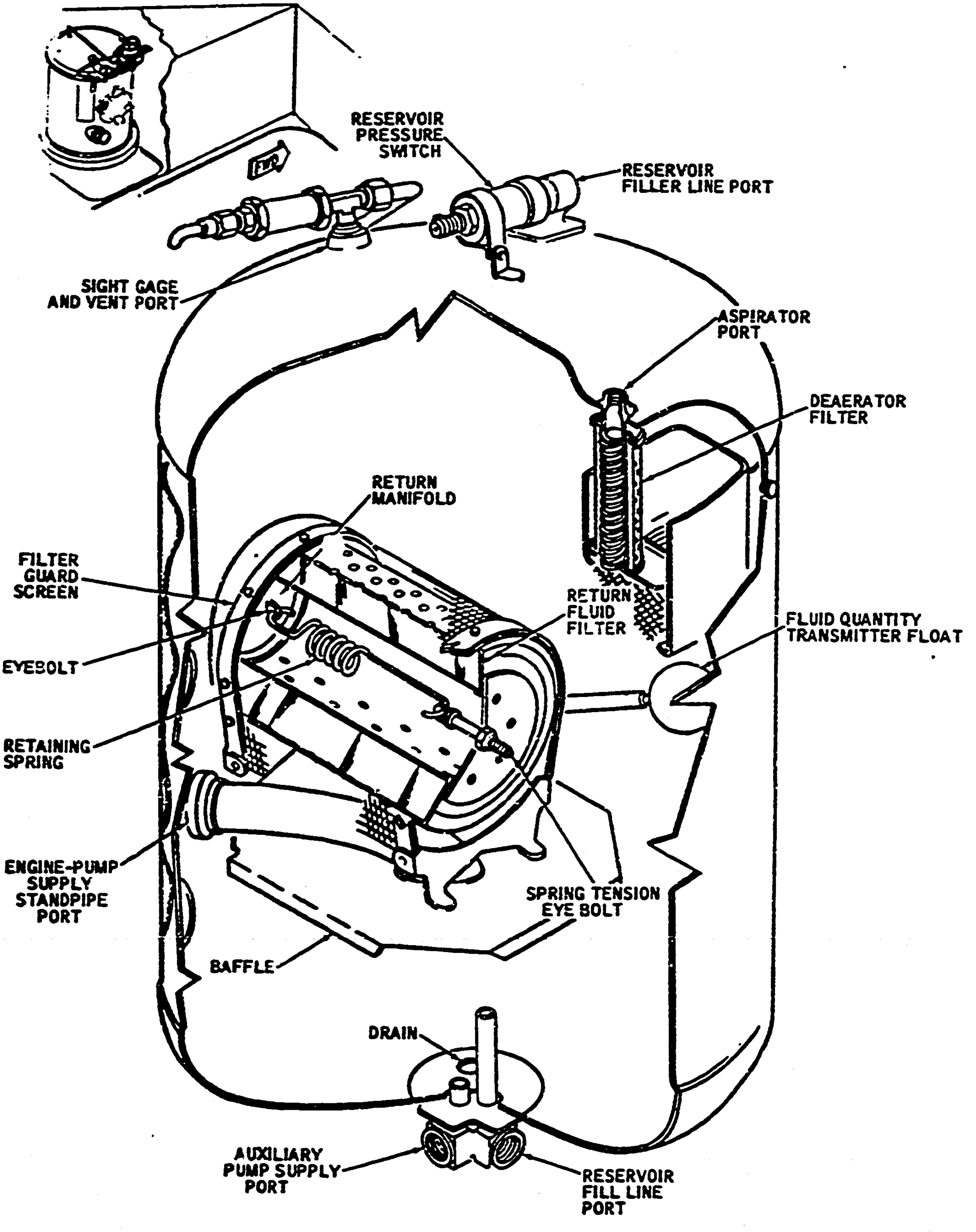
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The

filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

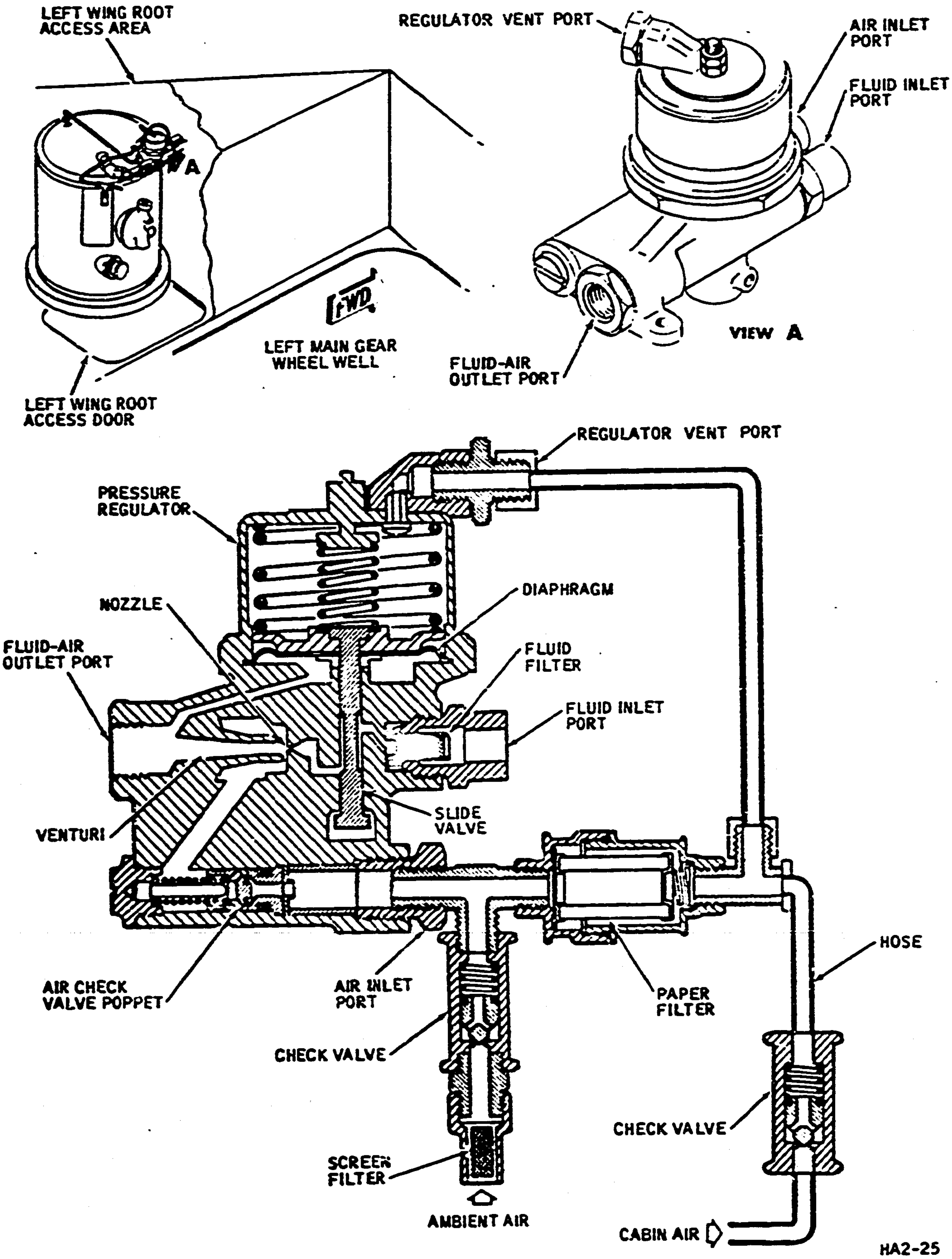
(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet plug. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

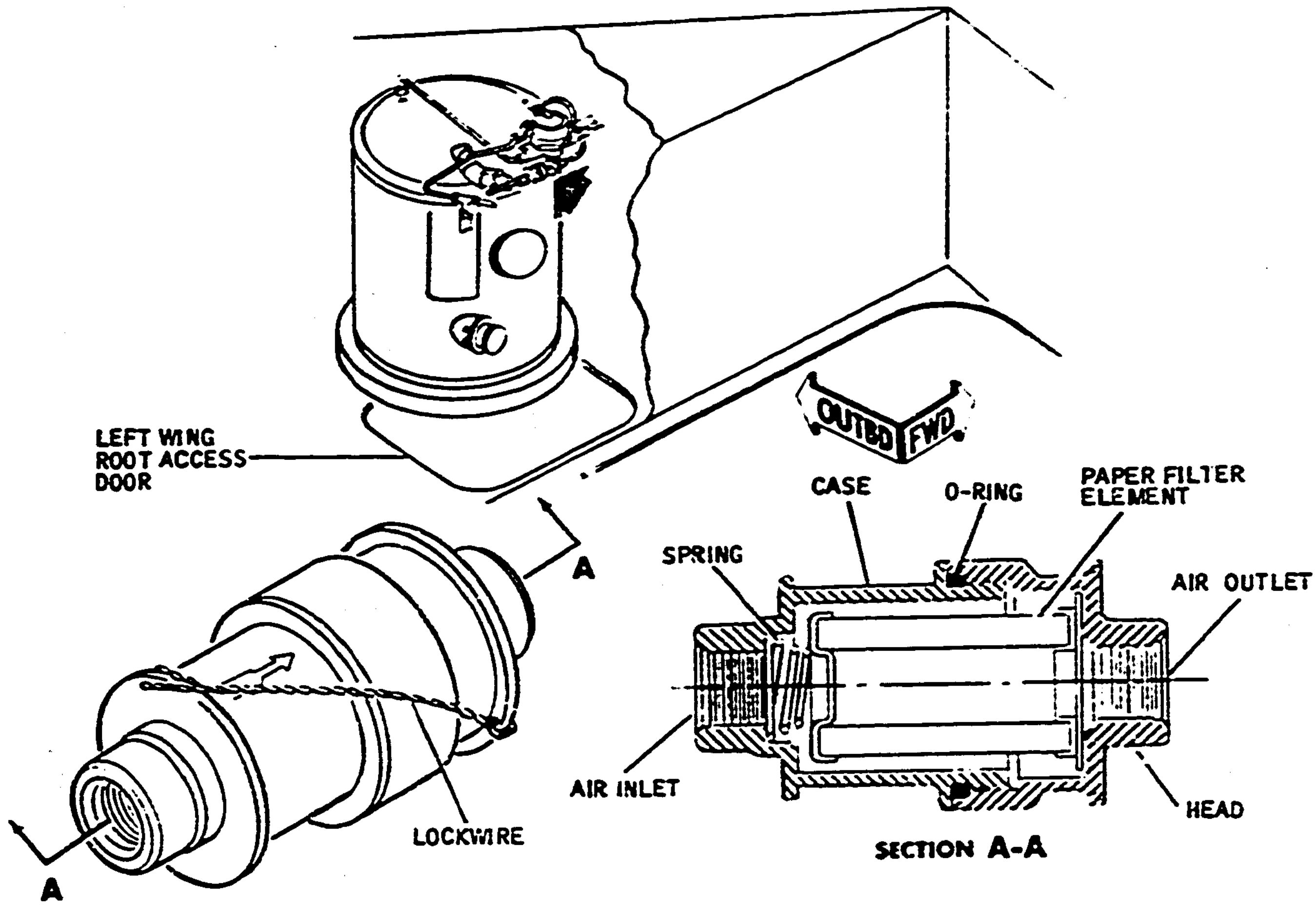
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

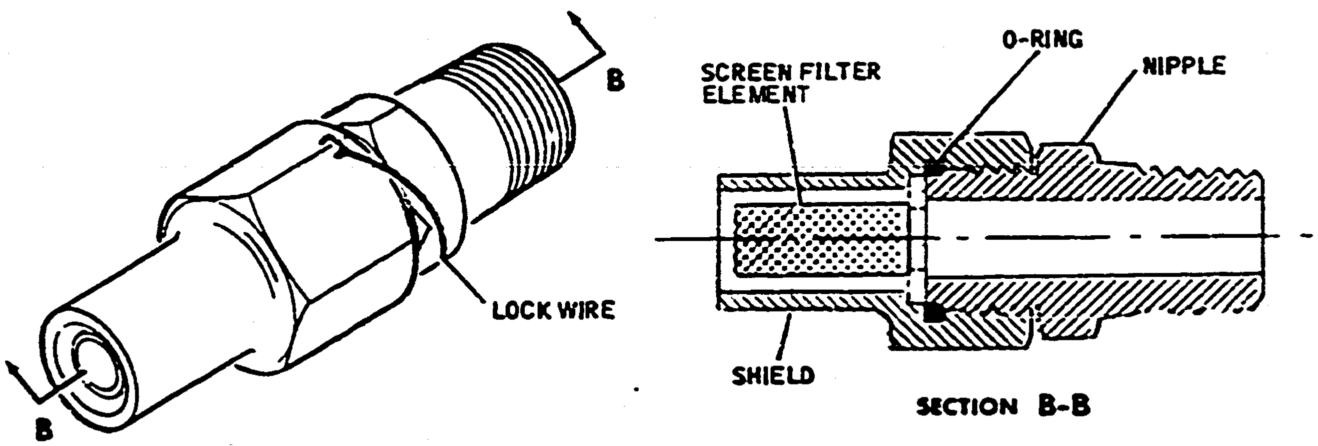
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir



PAPER ELEMENT FILTER



SCREEN FILTER

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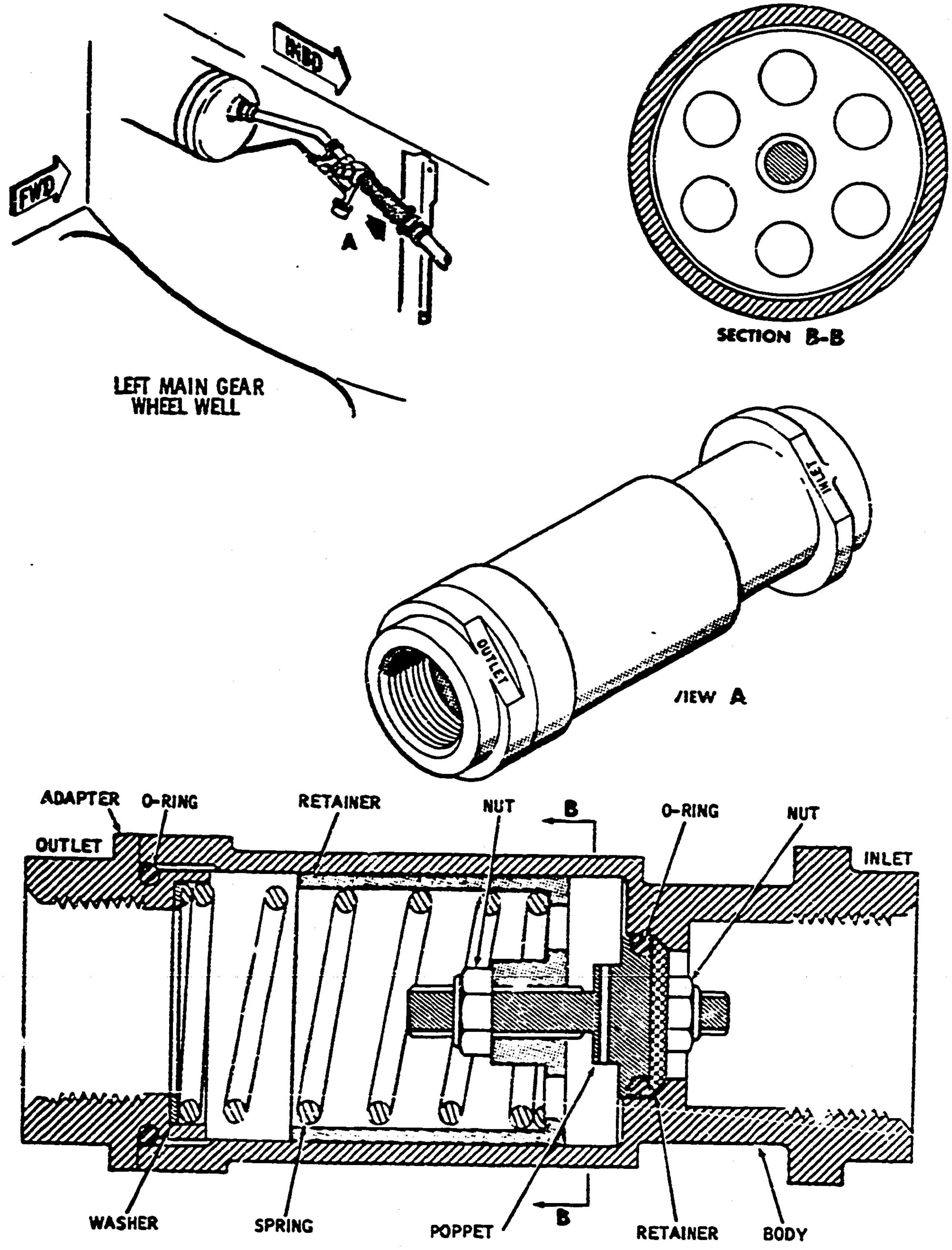
Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



Hydraulic Reservoir Relief Valve
Figure 7

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through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

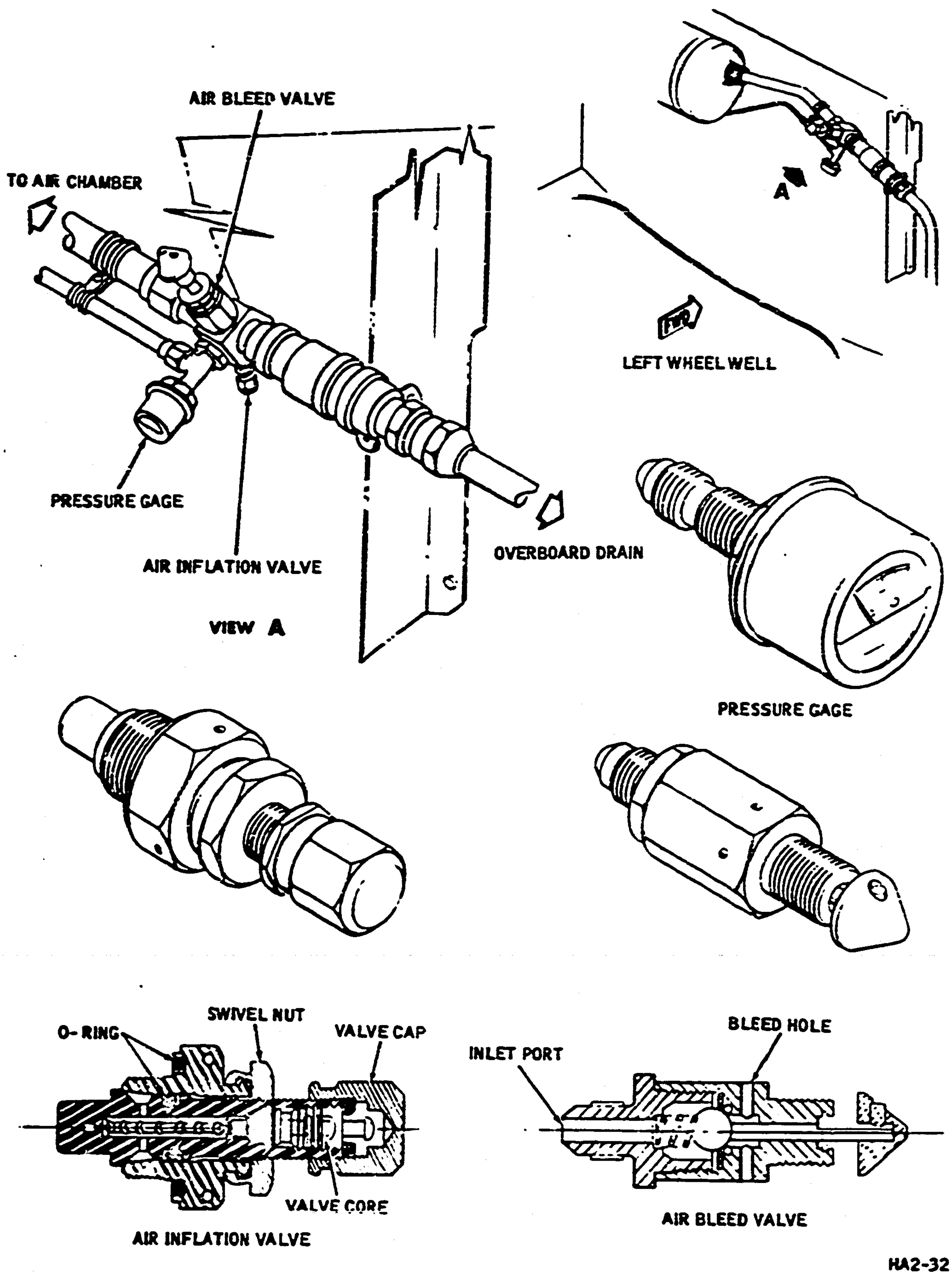
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

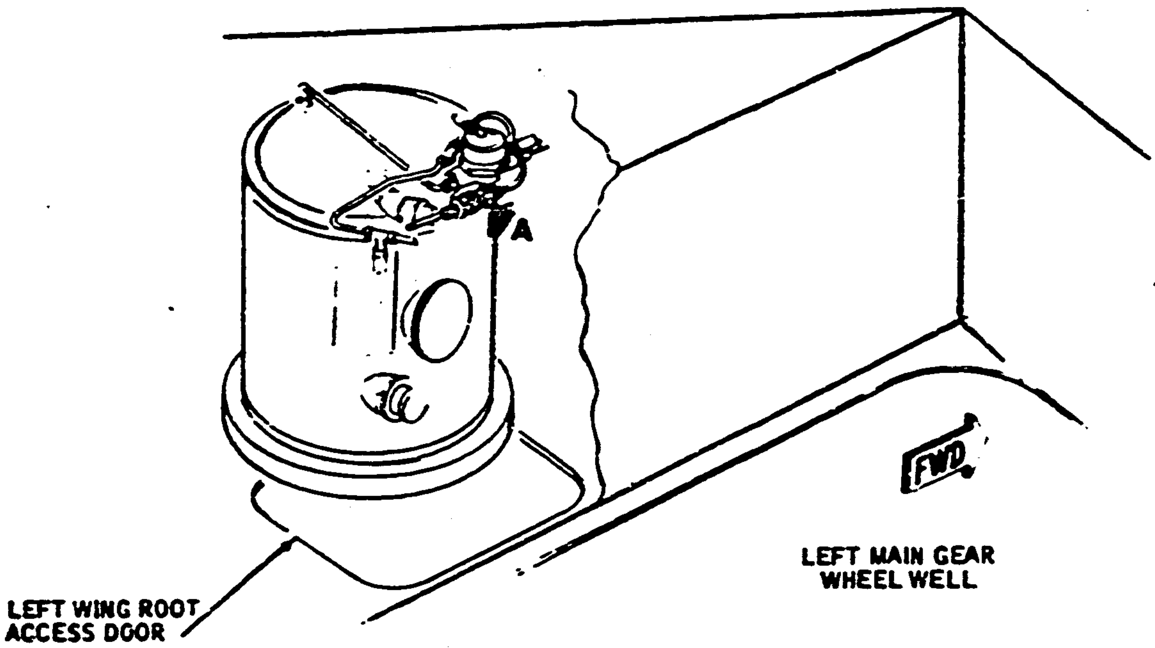
H. Hydraulic Reservoir Air Chamber

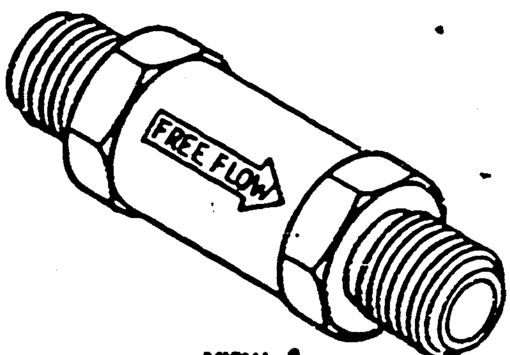
(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a

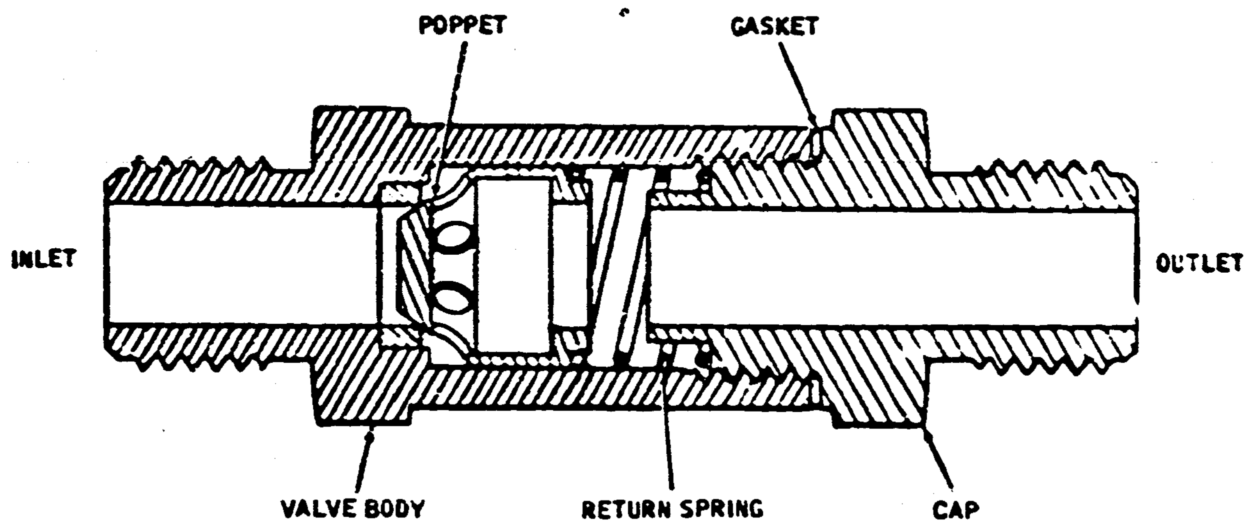


Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8





VIEW A



HA2-33

Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

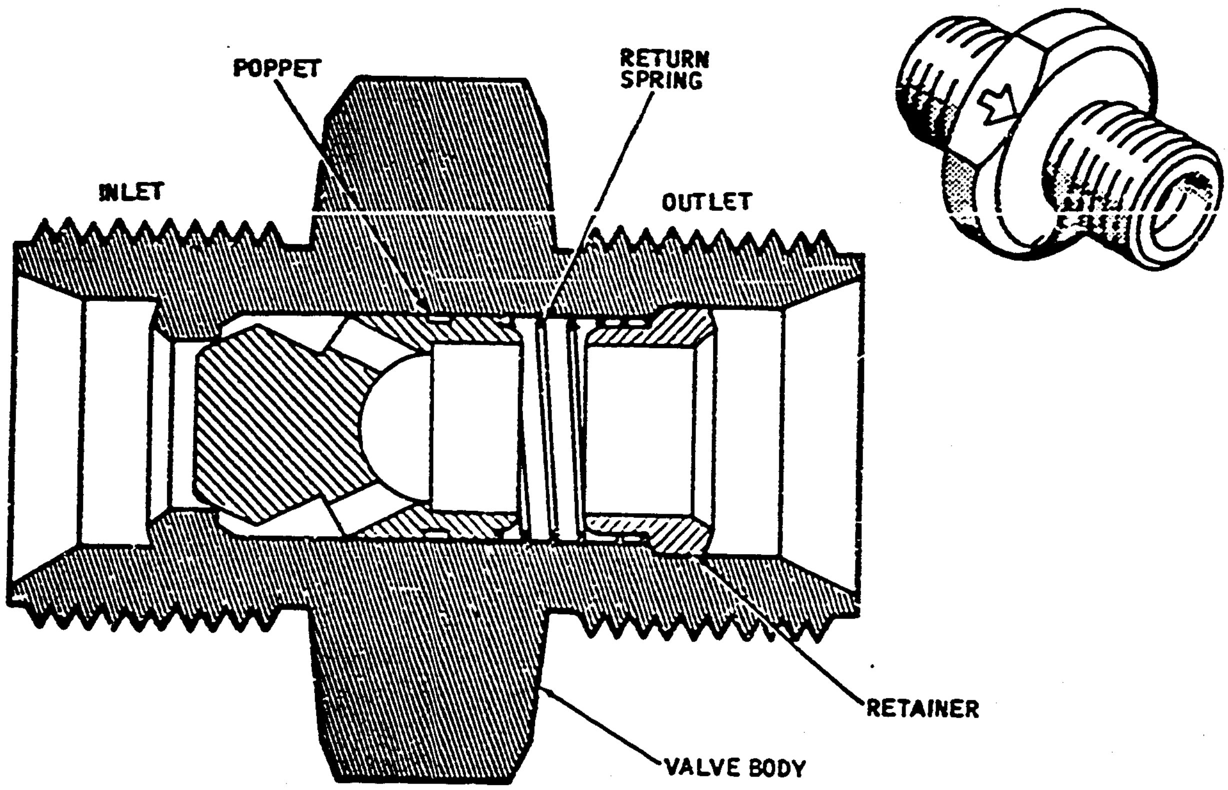
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

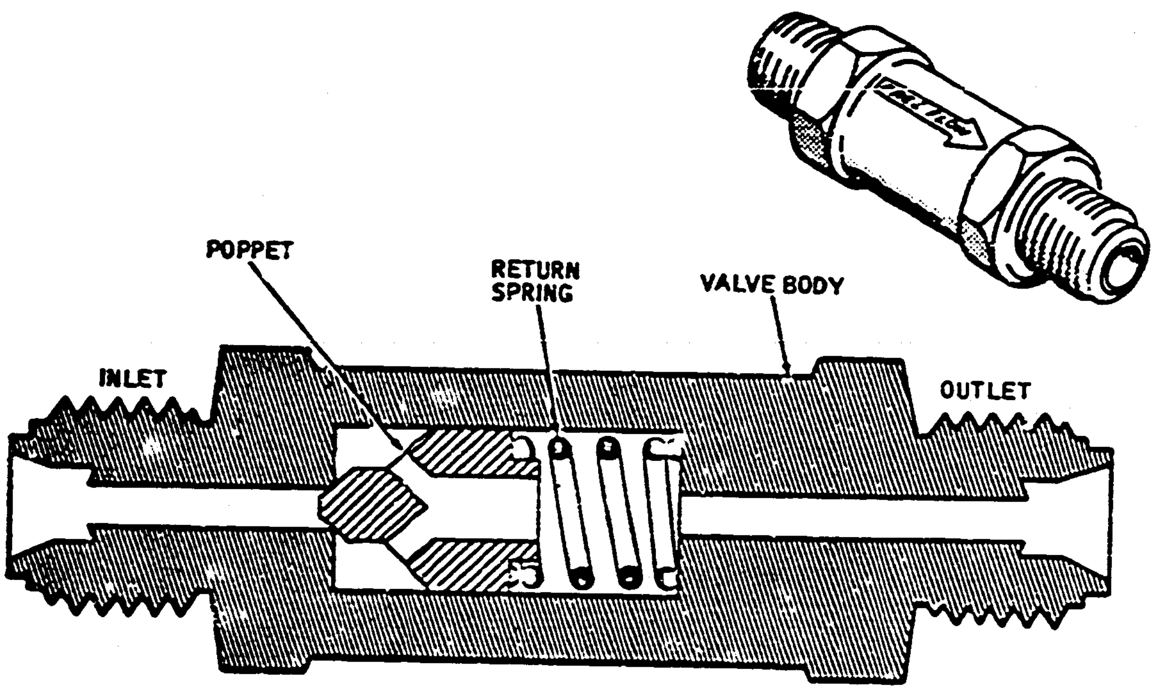
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two



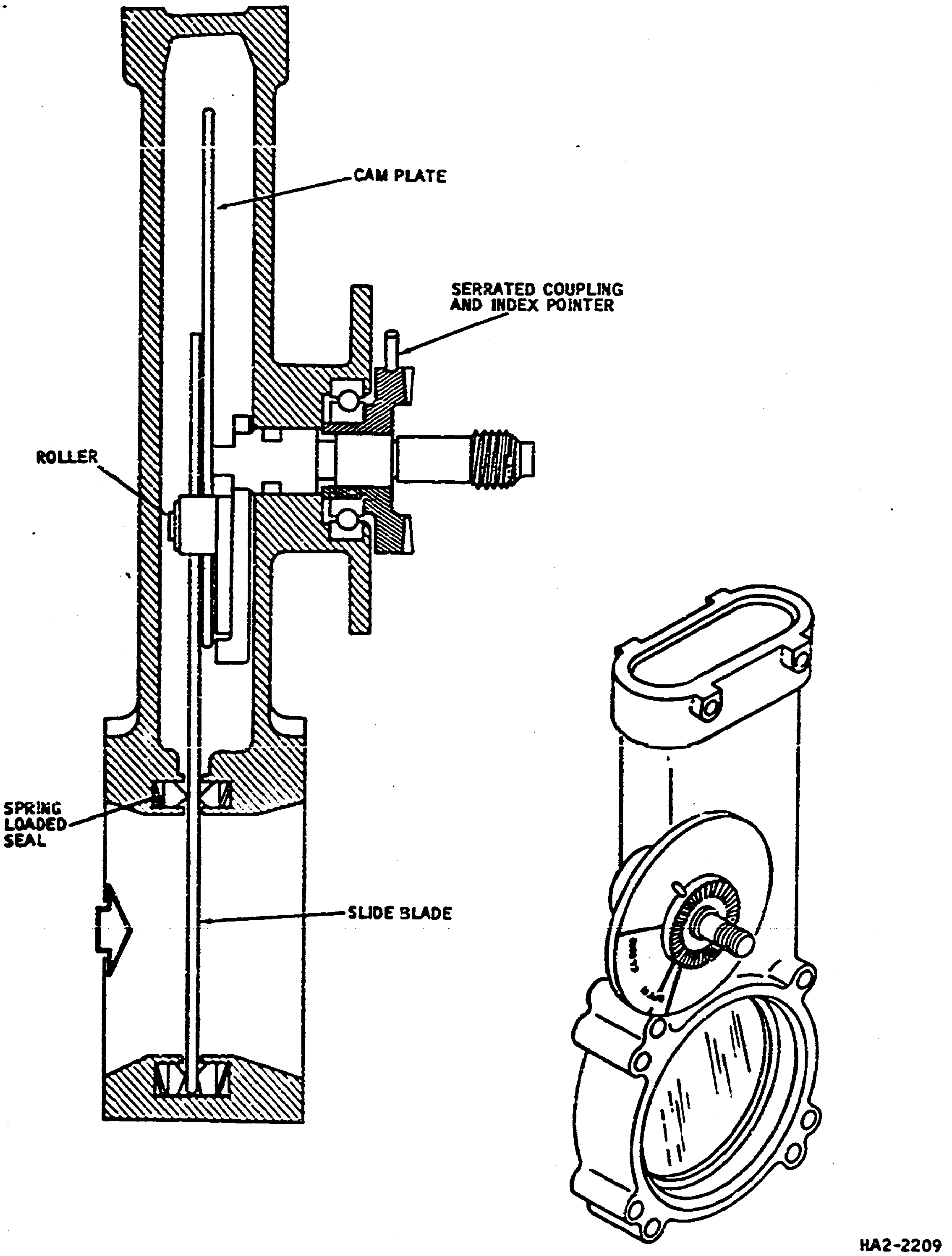
MINIATURE CHECK VALVE



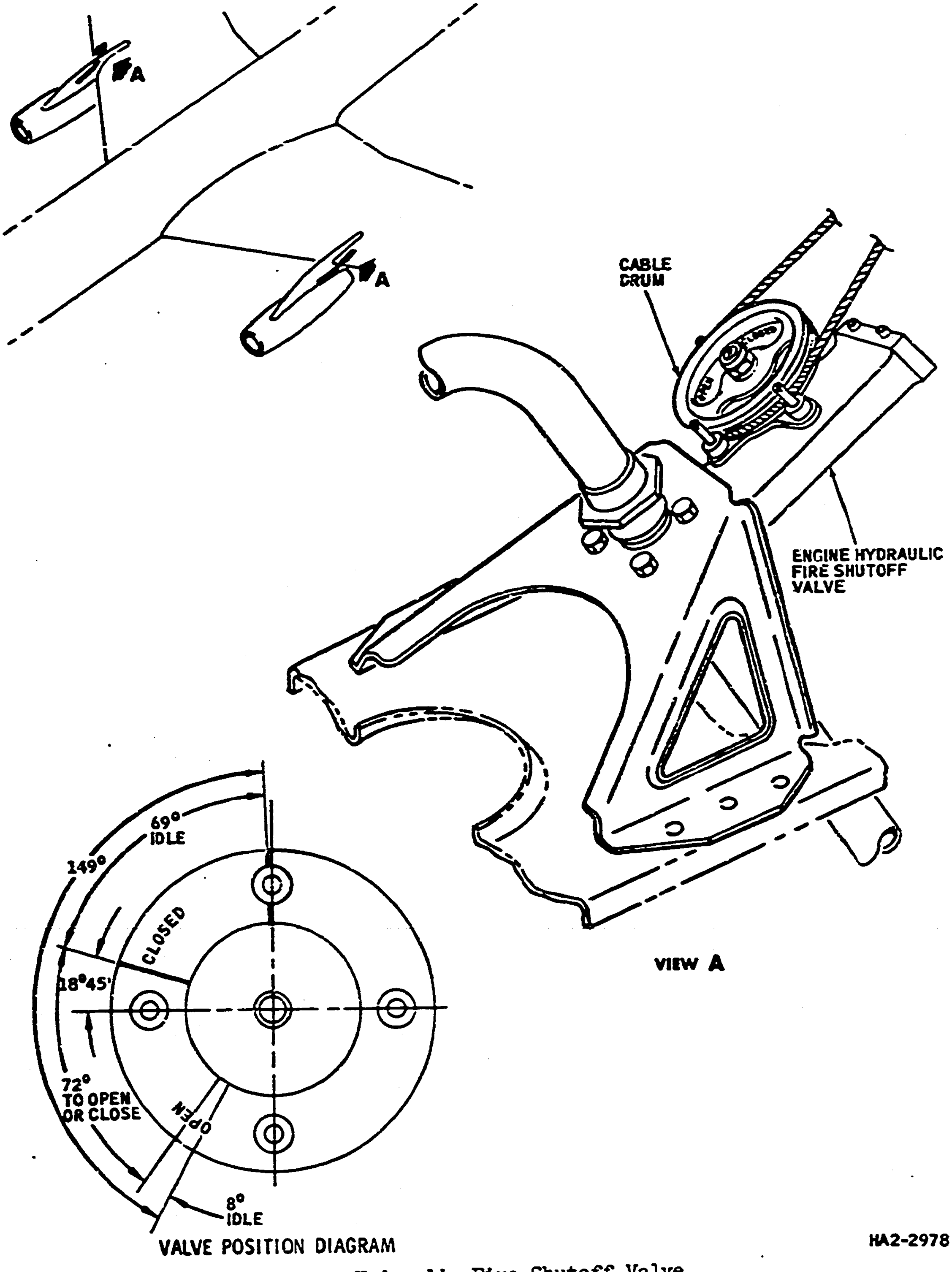
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

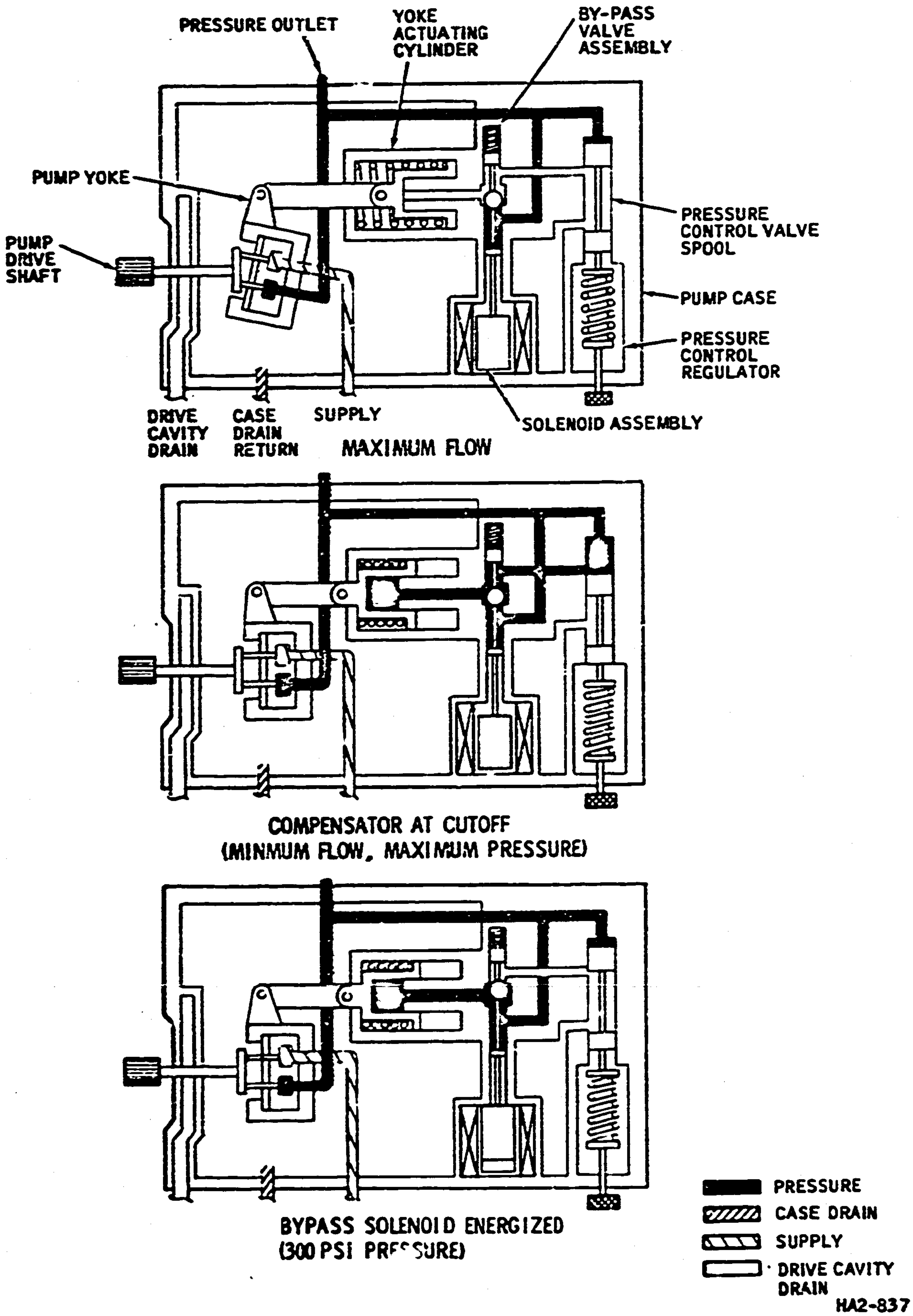
grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low pressure indicating light switch.



Engine-Driven Hydraulic Pump Pressure Flow -- Schematic
Figure 13

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating driven shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. If the engine-driven hydraulic pump control switches are in the on position and the output pressure of either pump drops below 1500 psi, an amber light located in the flight compartment comes on.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

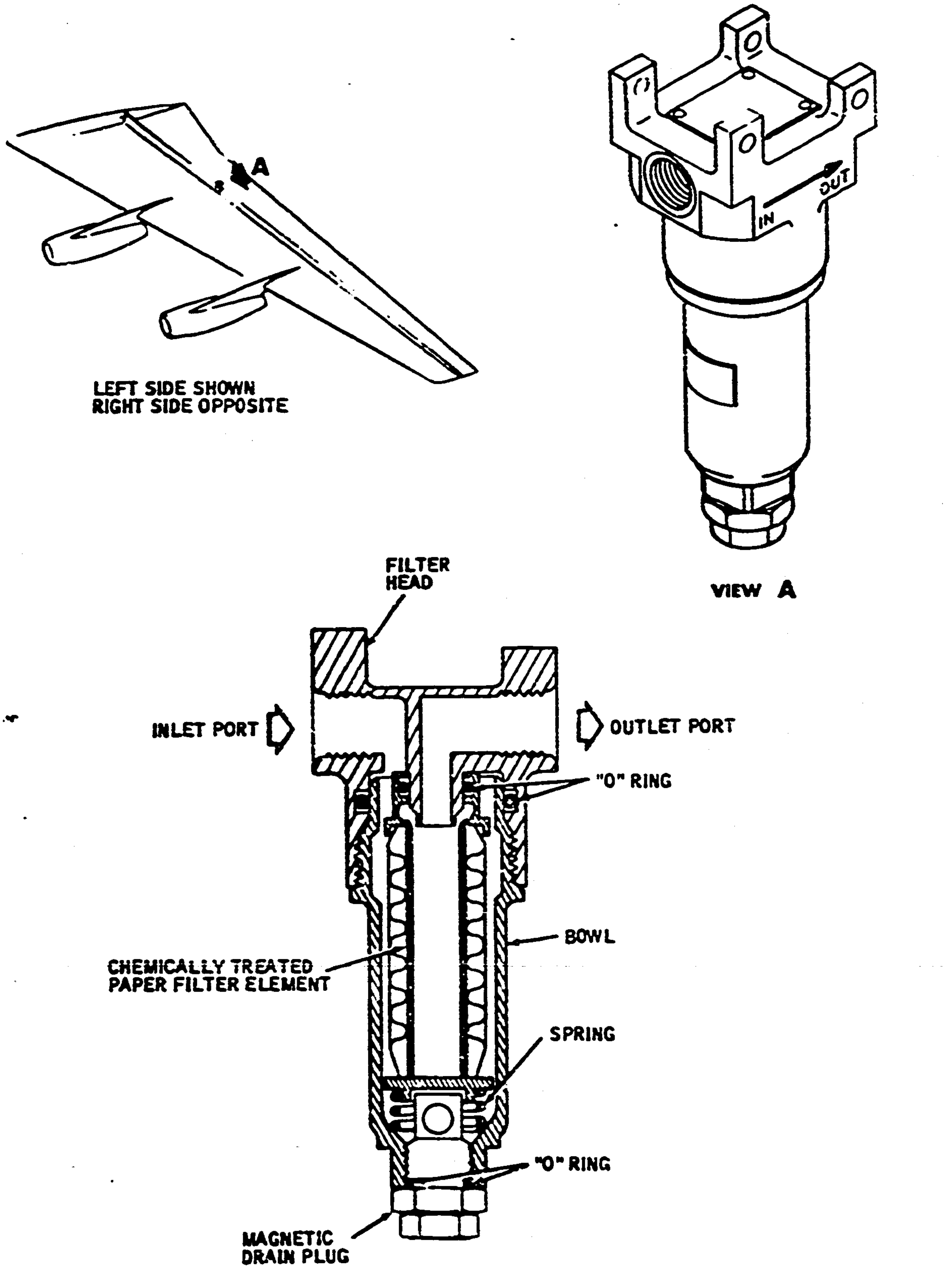
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

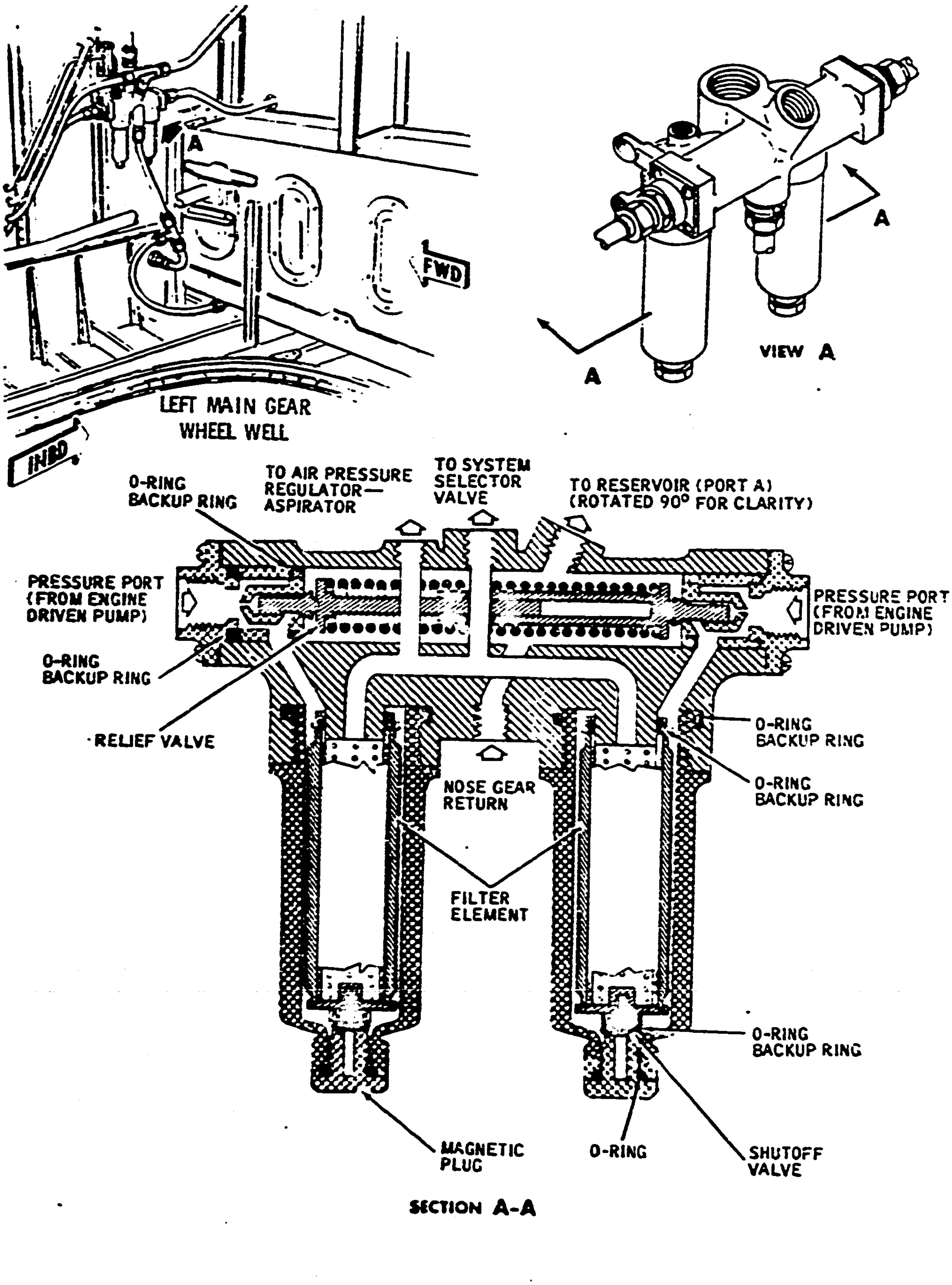
(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



Engine-Driven Hydraulic Pump Case Drain Filter -- Cutaway View
Figure 14



HA2-20

Dual-Filter and Relief Valve -- Cutaway Valve
Figure 15

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

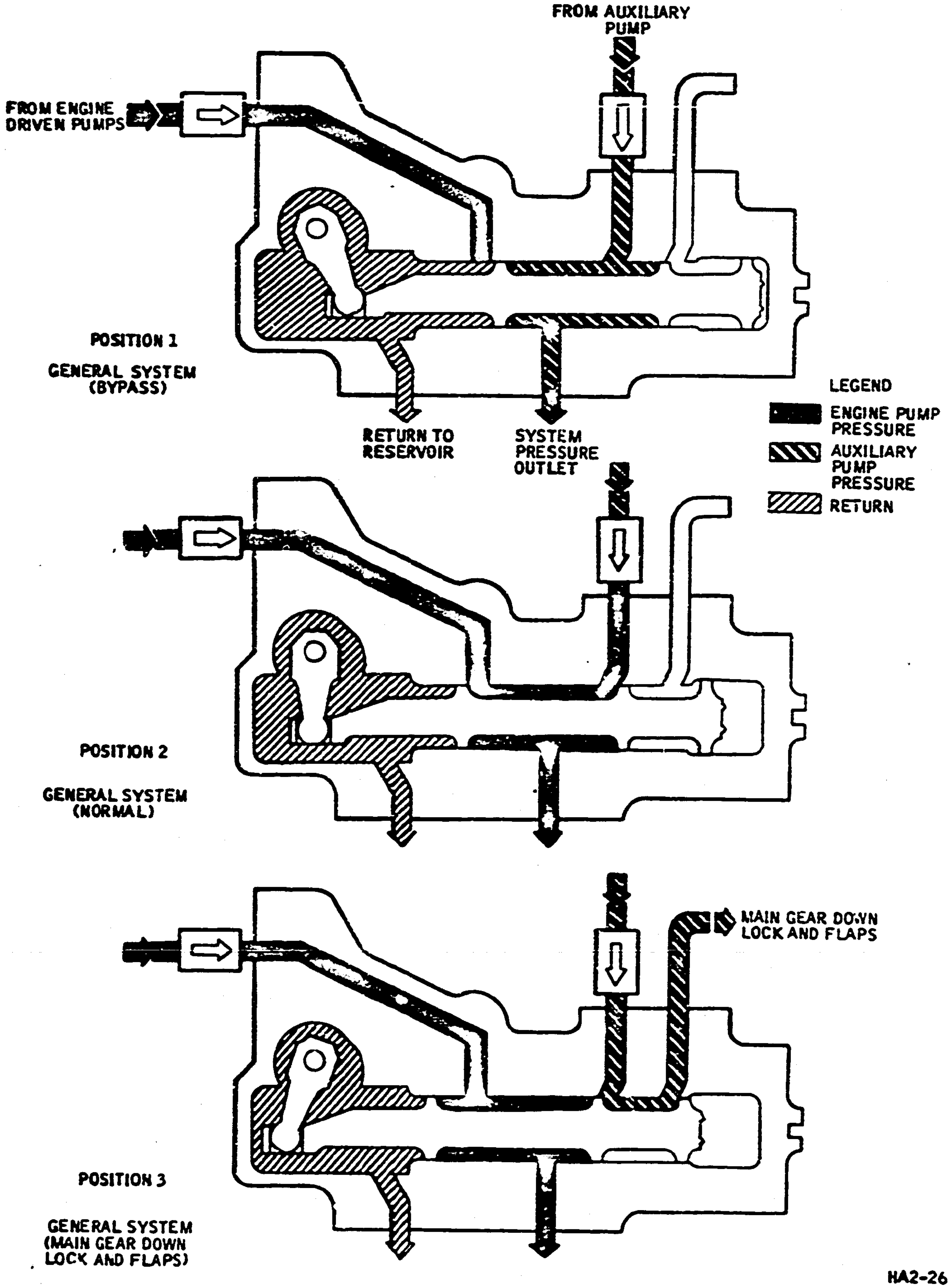
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

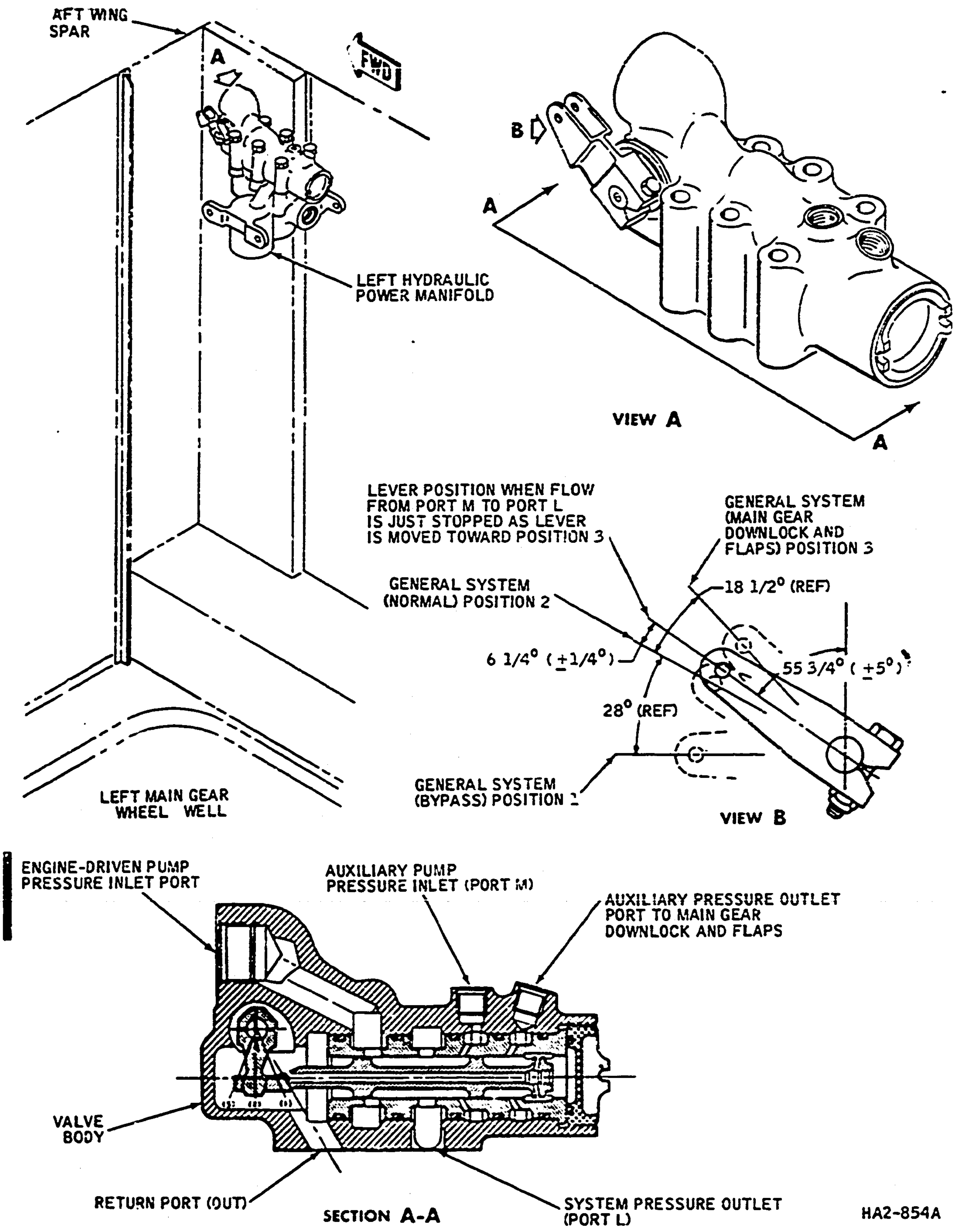
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

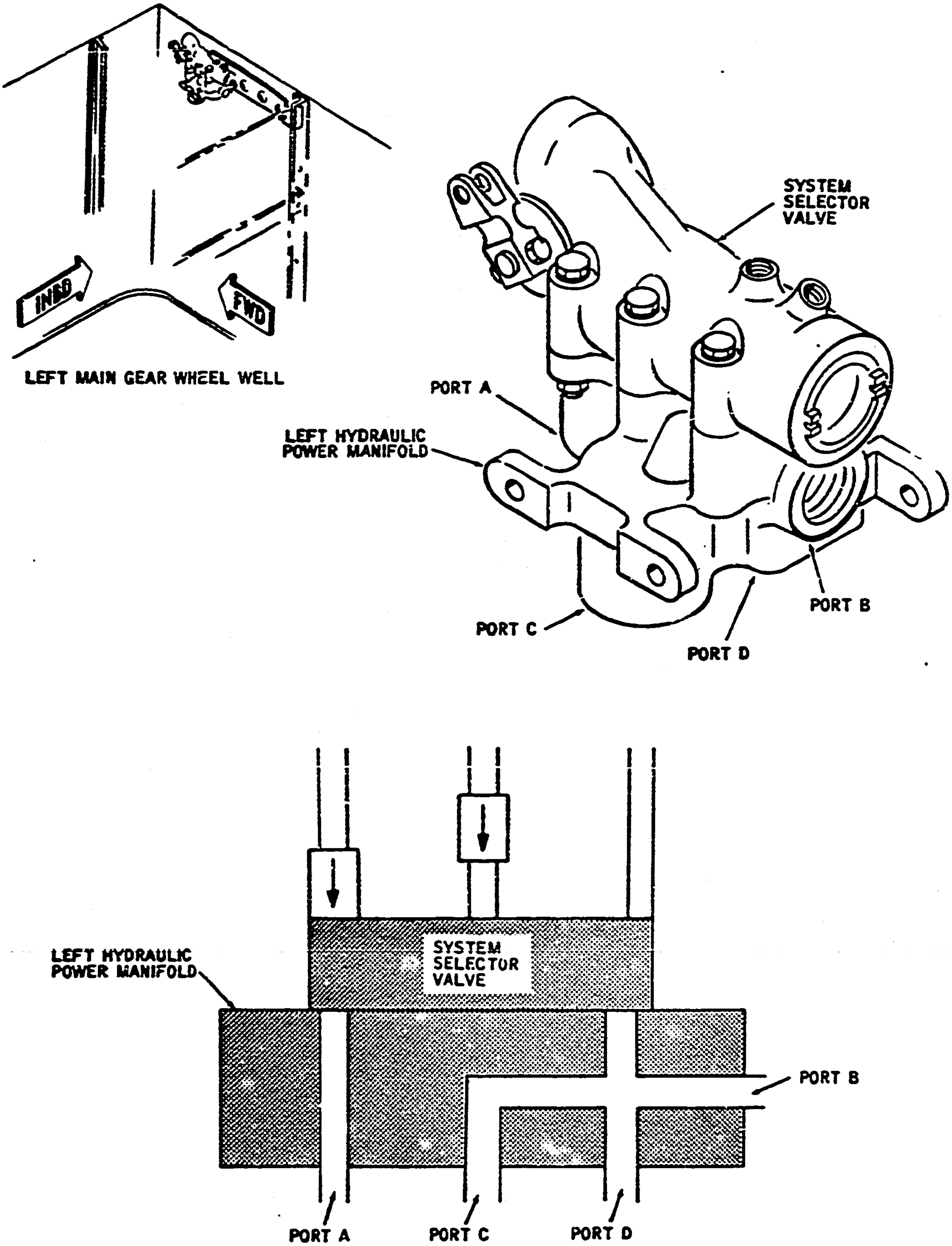
(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17



Left Hydraulic Power Manifold -- Schematic
Figure 18

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

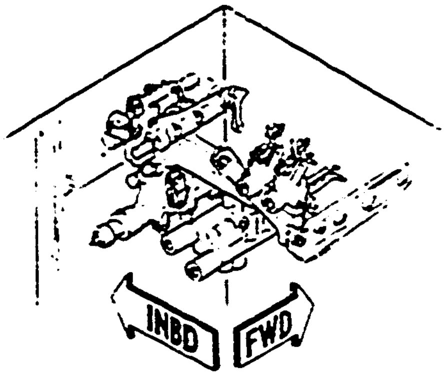
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

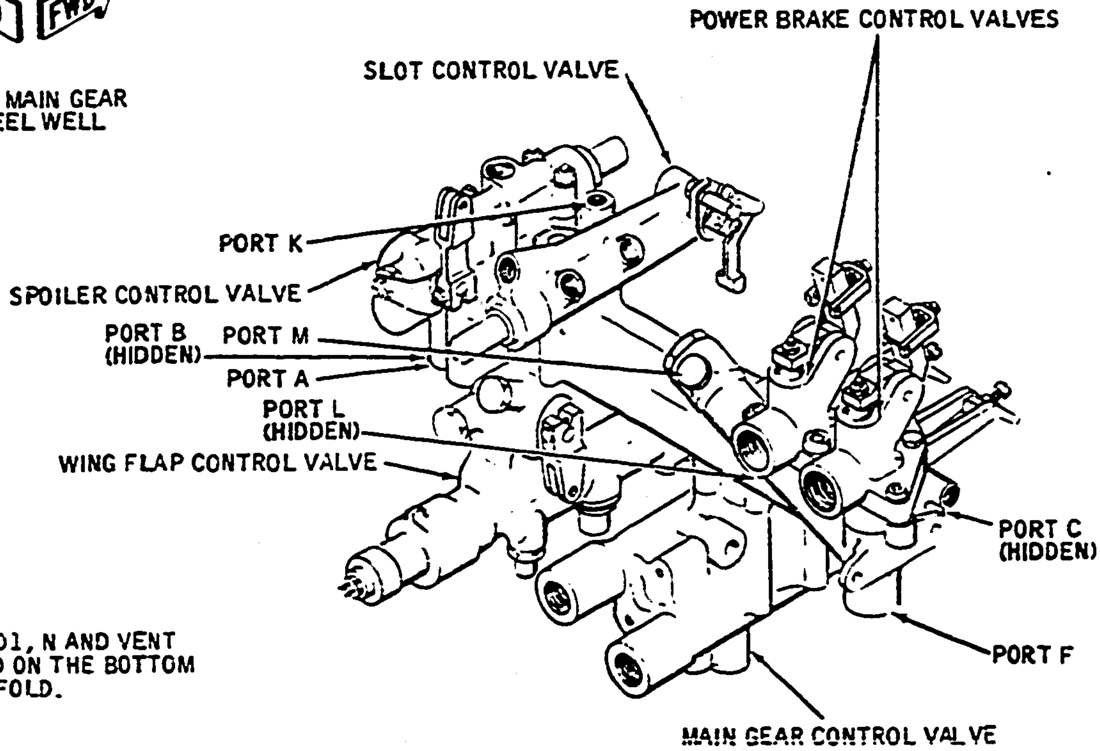
(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

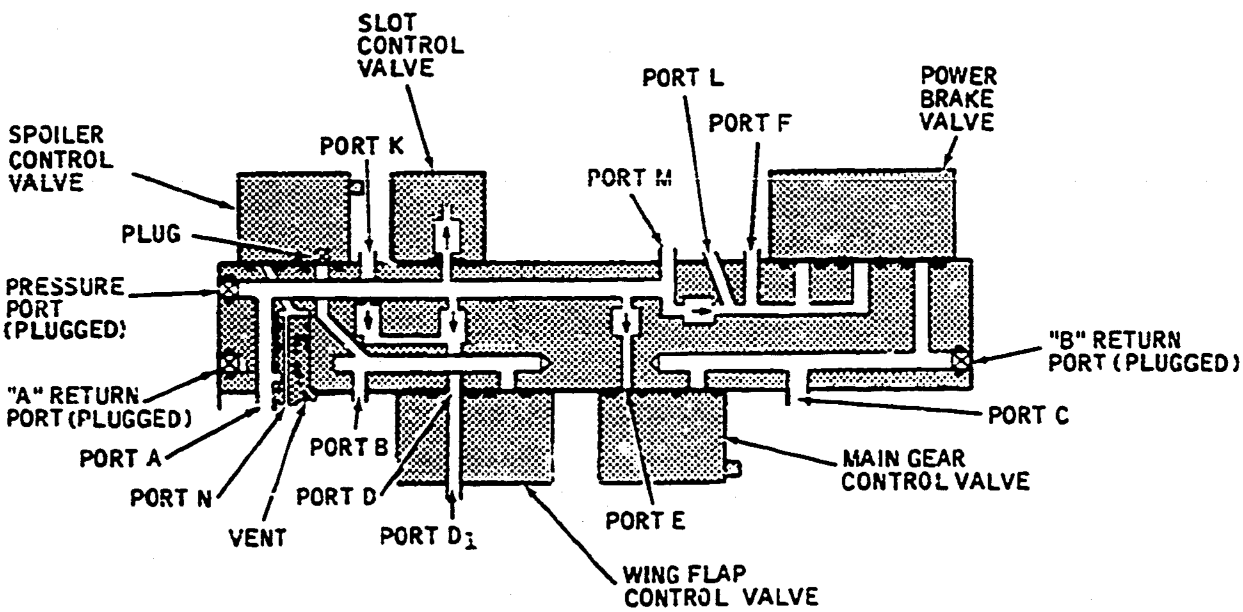
R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

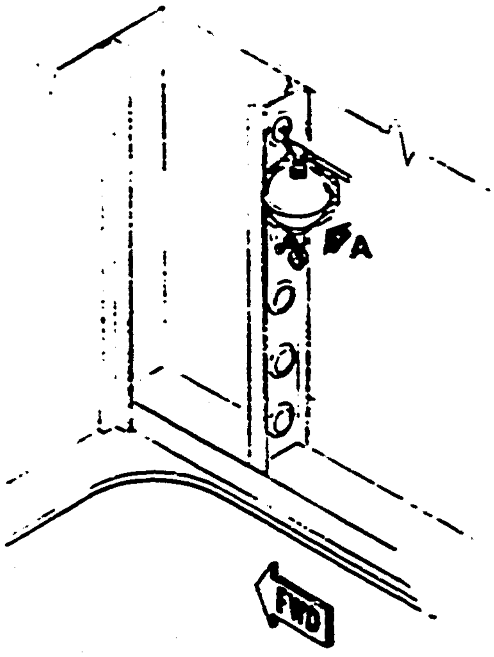




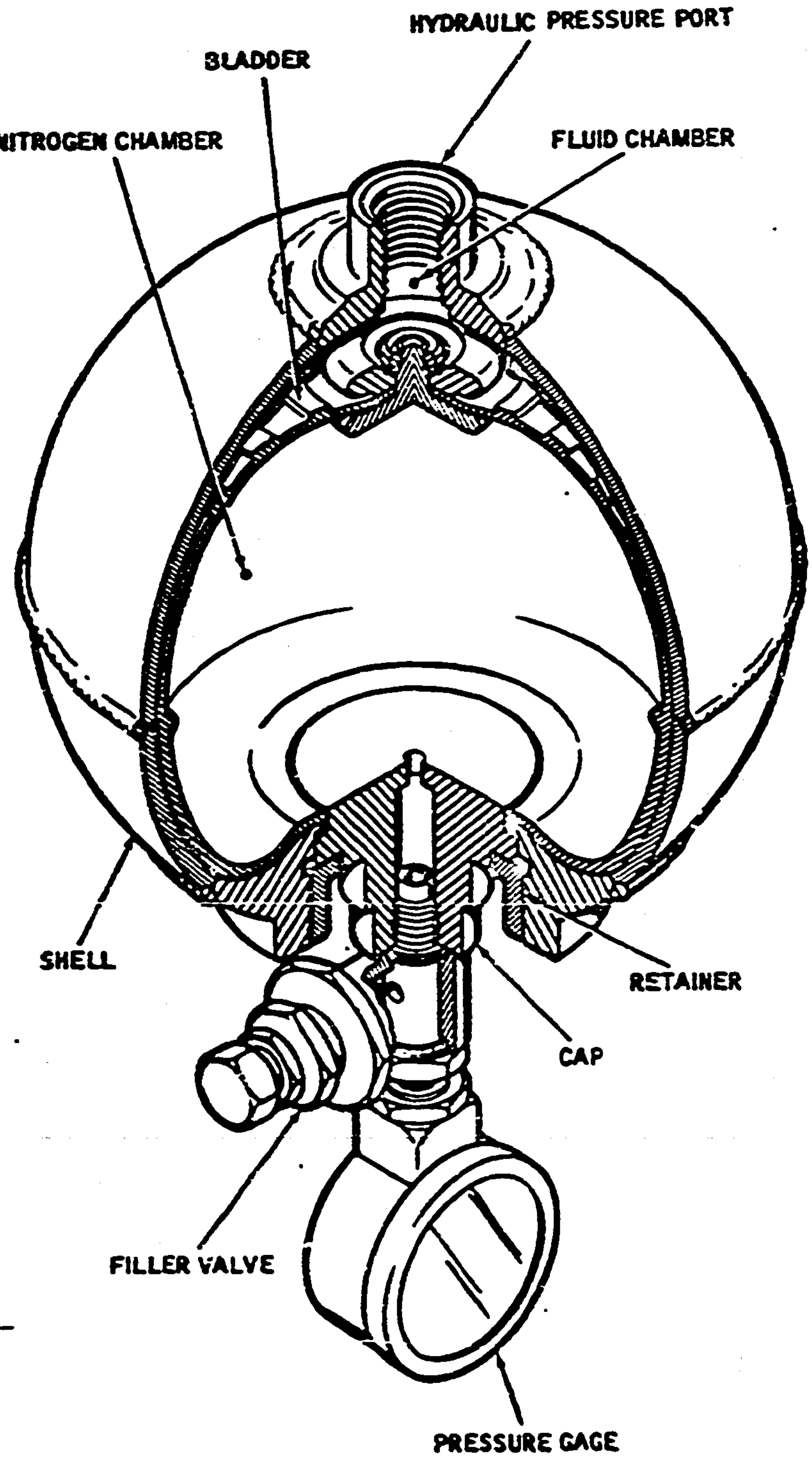


HA2-29A

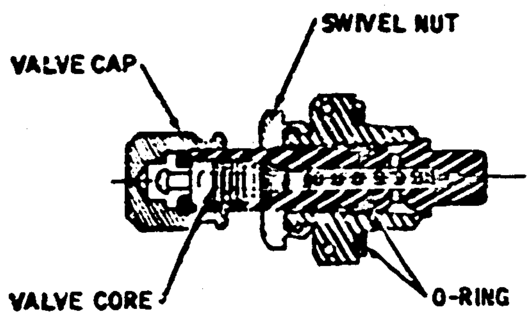
Right Hydraulic Power Manifold -- Schematic
Figure 19



LEFT MAIN GEAR
WHEEL WELL



VIEW A



FILLER VALVE

HA2-30

Hydraulic Power System Accumulator -- Cutaway View
Figure 20

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

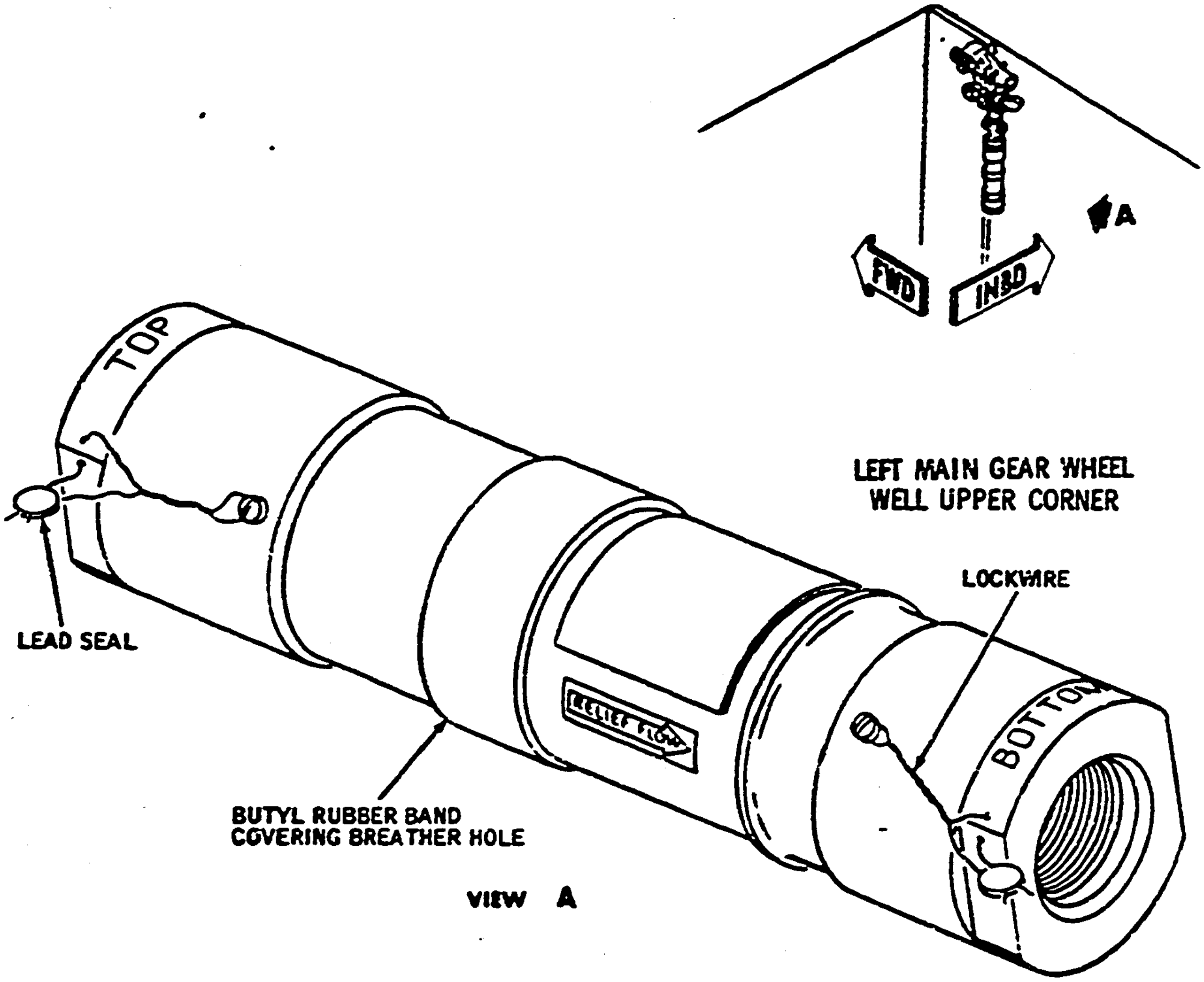
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

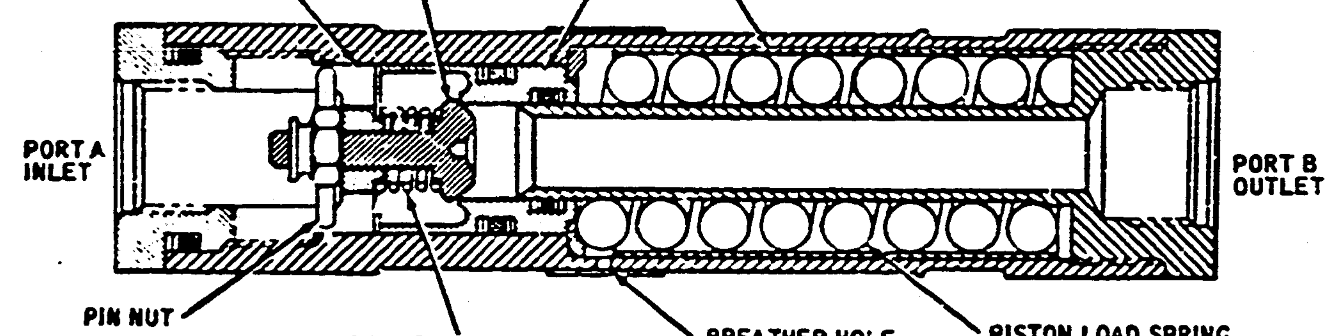
T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.





HA2-856

Hydraulic System Priority Valve -- Cutaway View
Figure 21

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out

of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

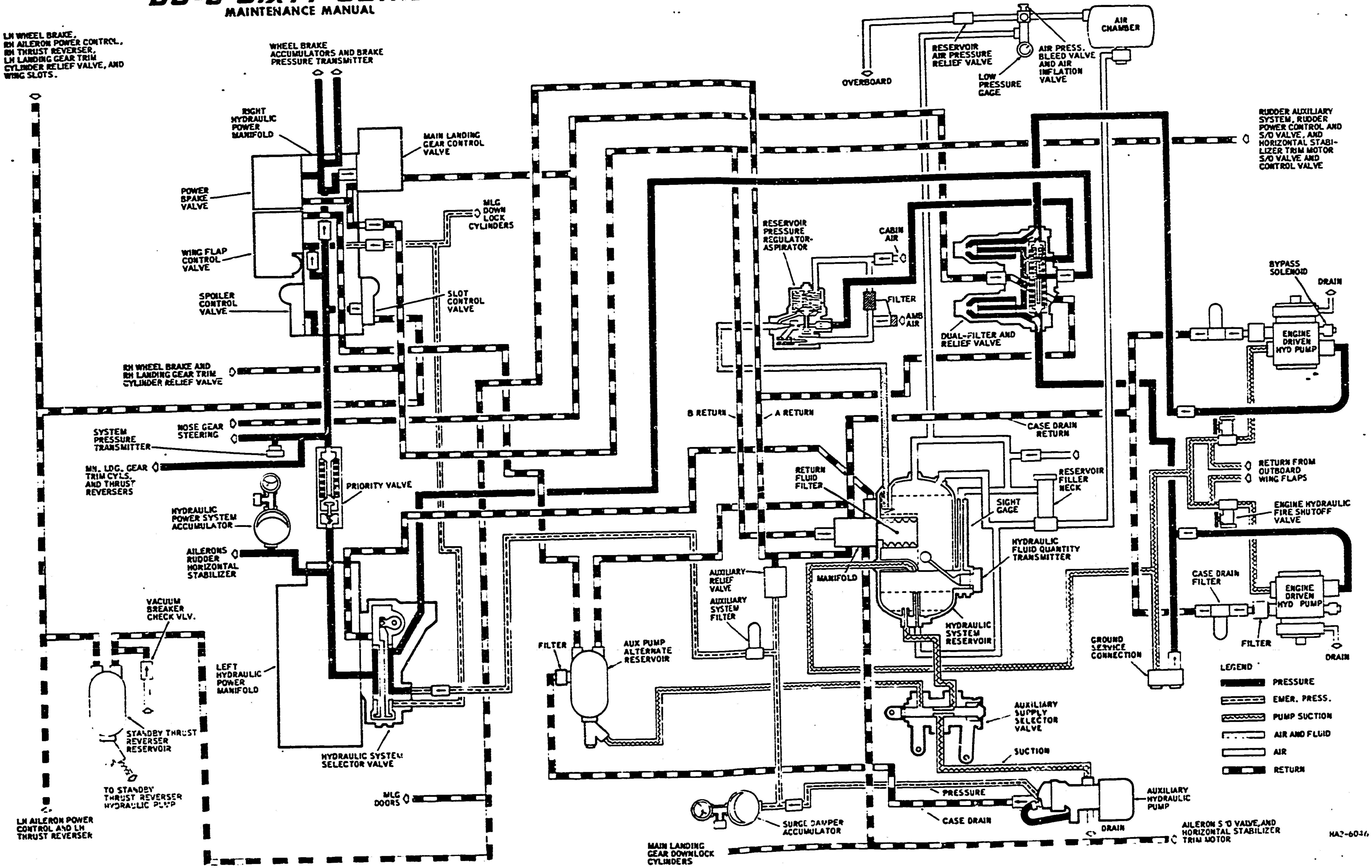
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

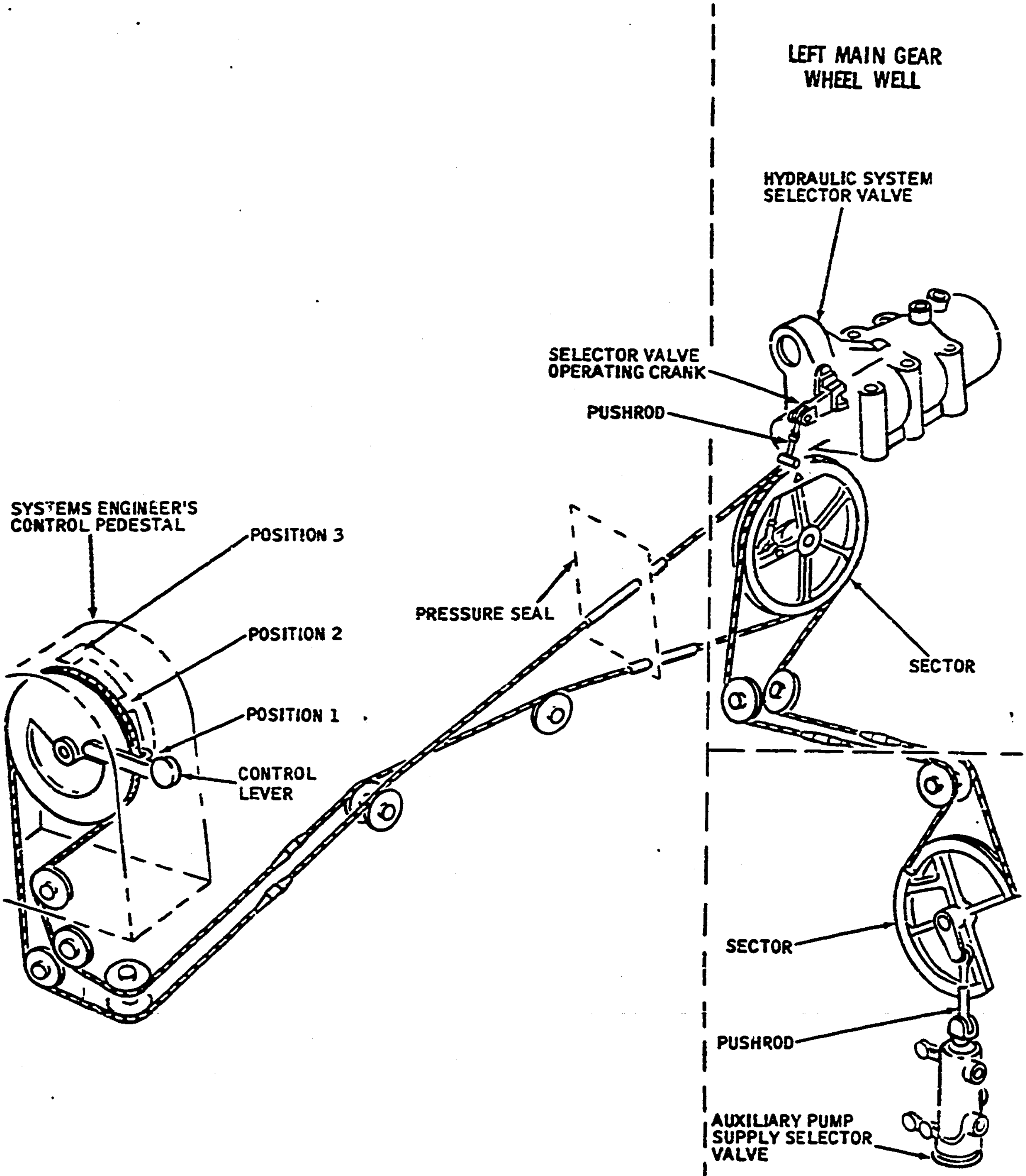
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10 7 Imperial gallons; 48.8 liters) are available to to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the



Hydraulic Power System -- Schematic Diagram
Figure 1



CONTROL POSITIONS

1. BYPASS/GENERAL SYSTEM
2. GENERAL SYSTEM (NORMAL)
3. GENERAL SYSTEM/MAIN GEAR DOWN AND FLAPS

HA2-486

Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Bogie unlock

(b) Aileron power shutoff

(c) Rudder power shutoff

(d) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. The return port of the bogie unlock valve ports fluid

from the left manifold to the bogie return port of the reservoir. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

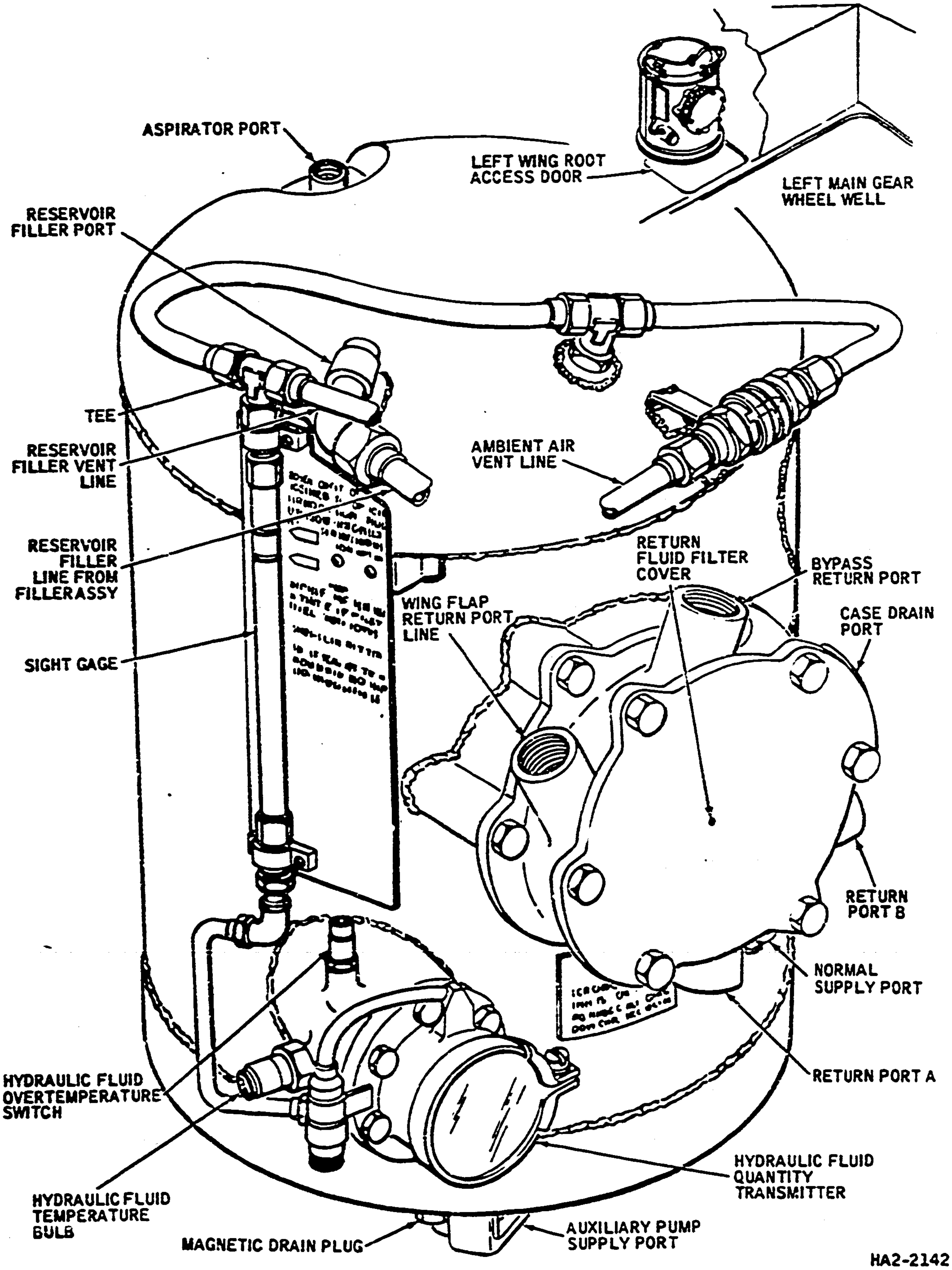
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

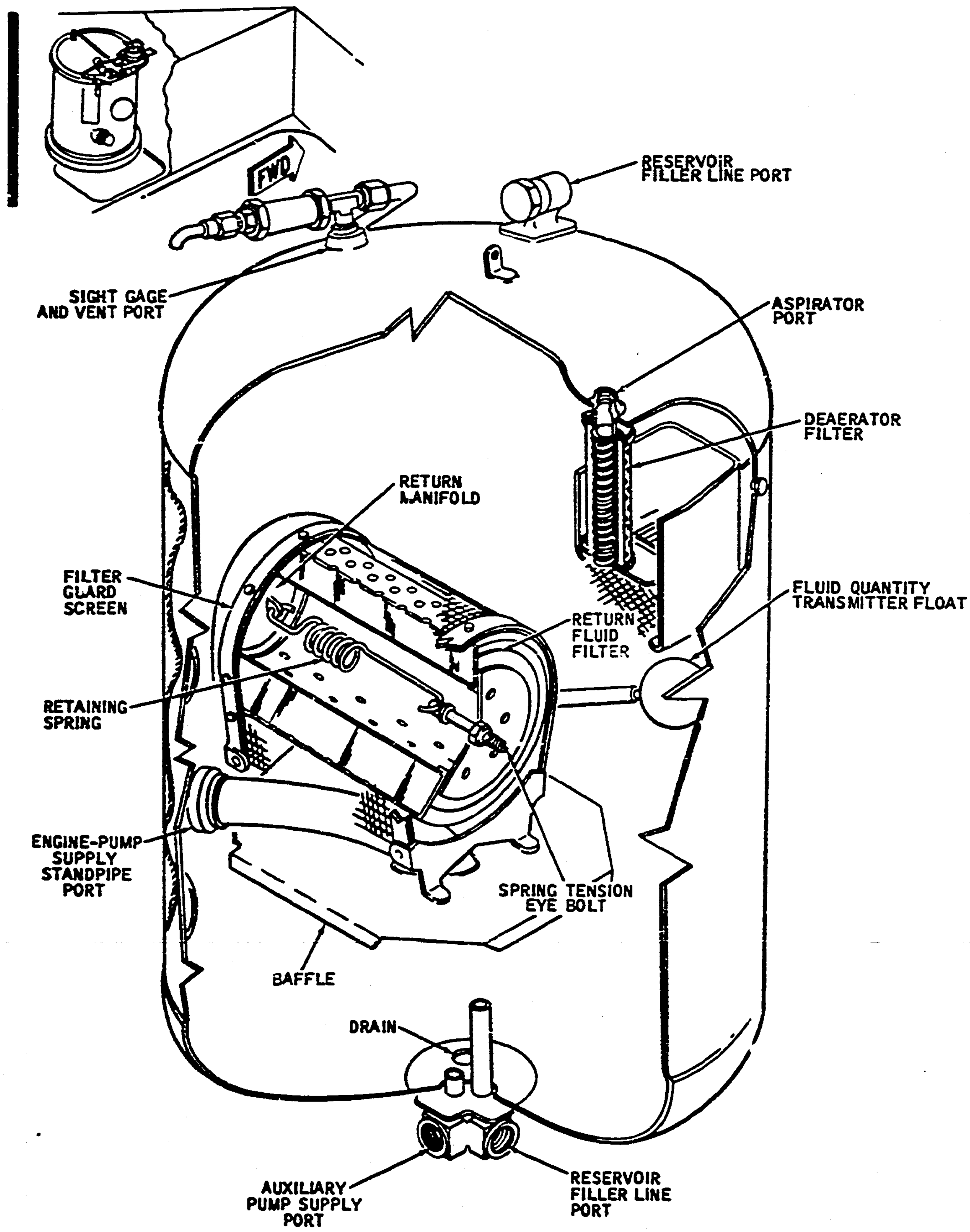
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure -

normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to between 30 and 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the other manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

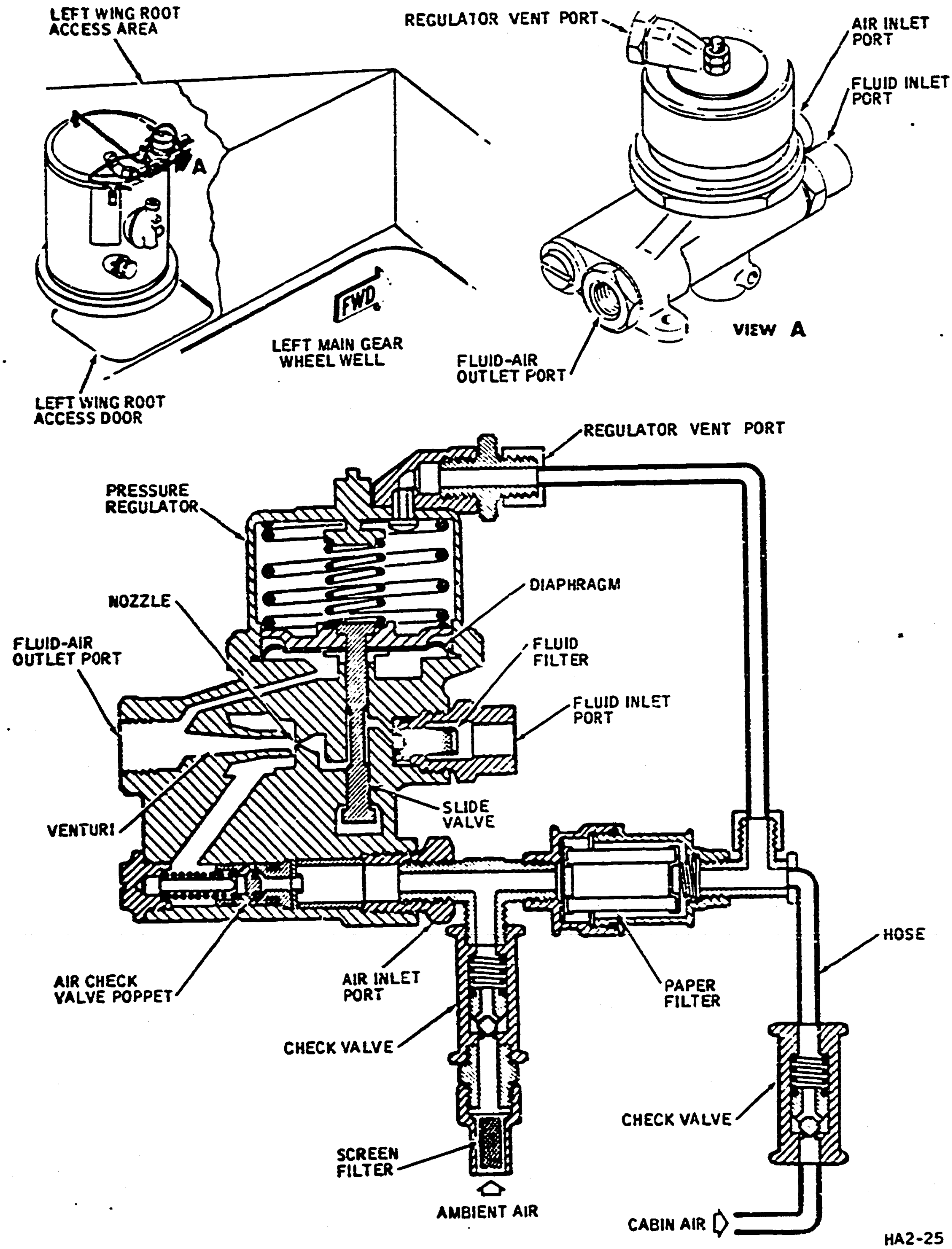
(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

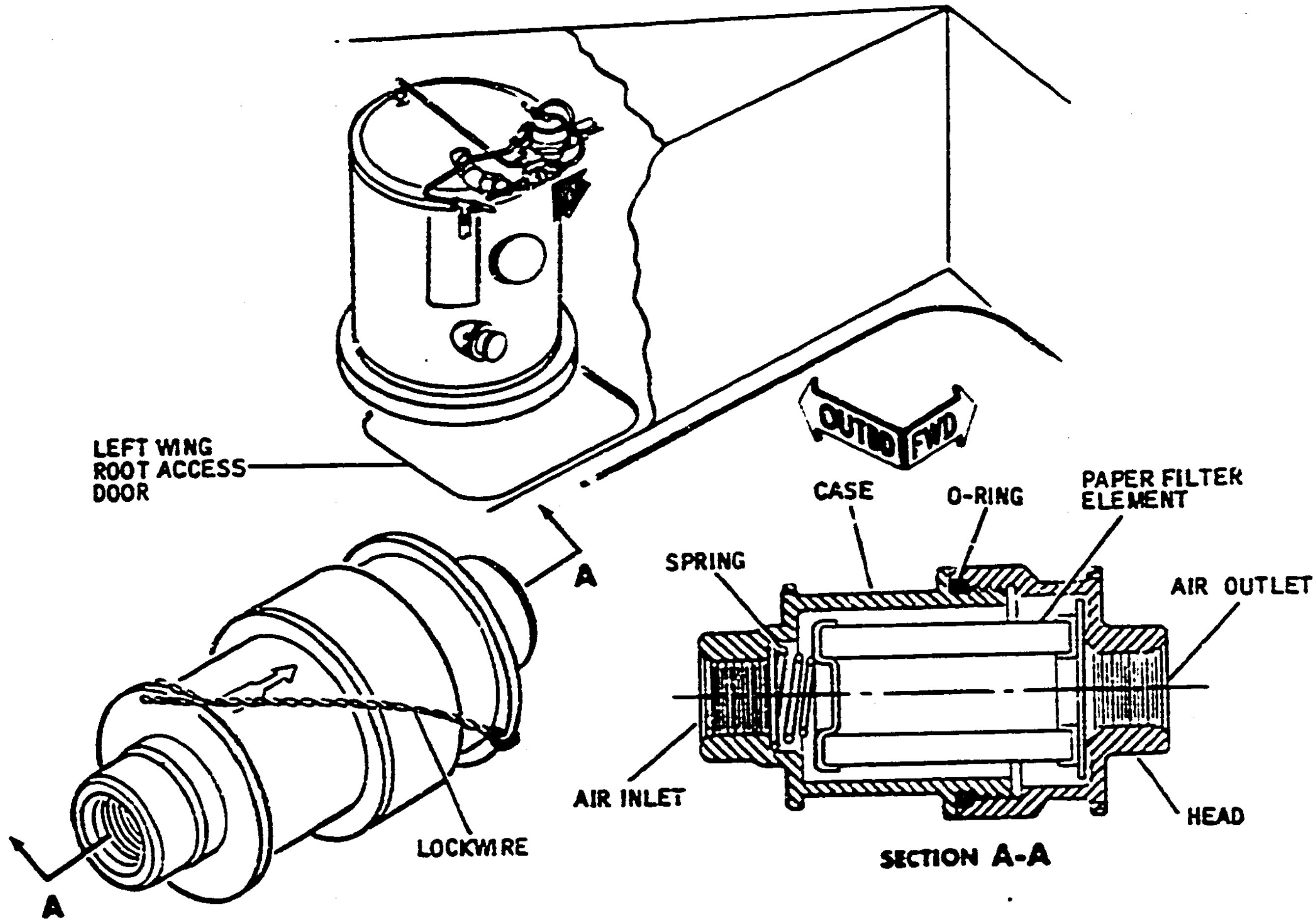
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-apsirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

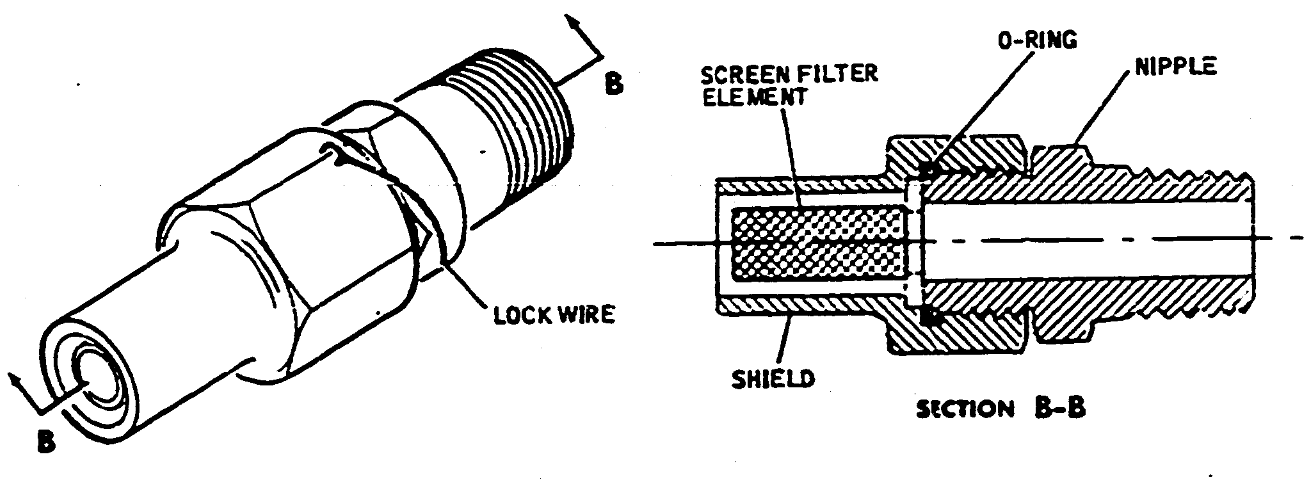
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen



PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

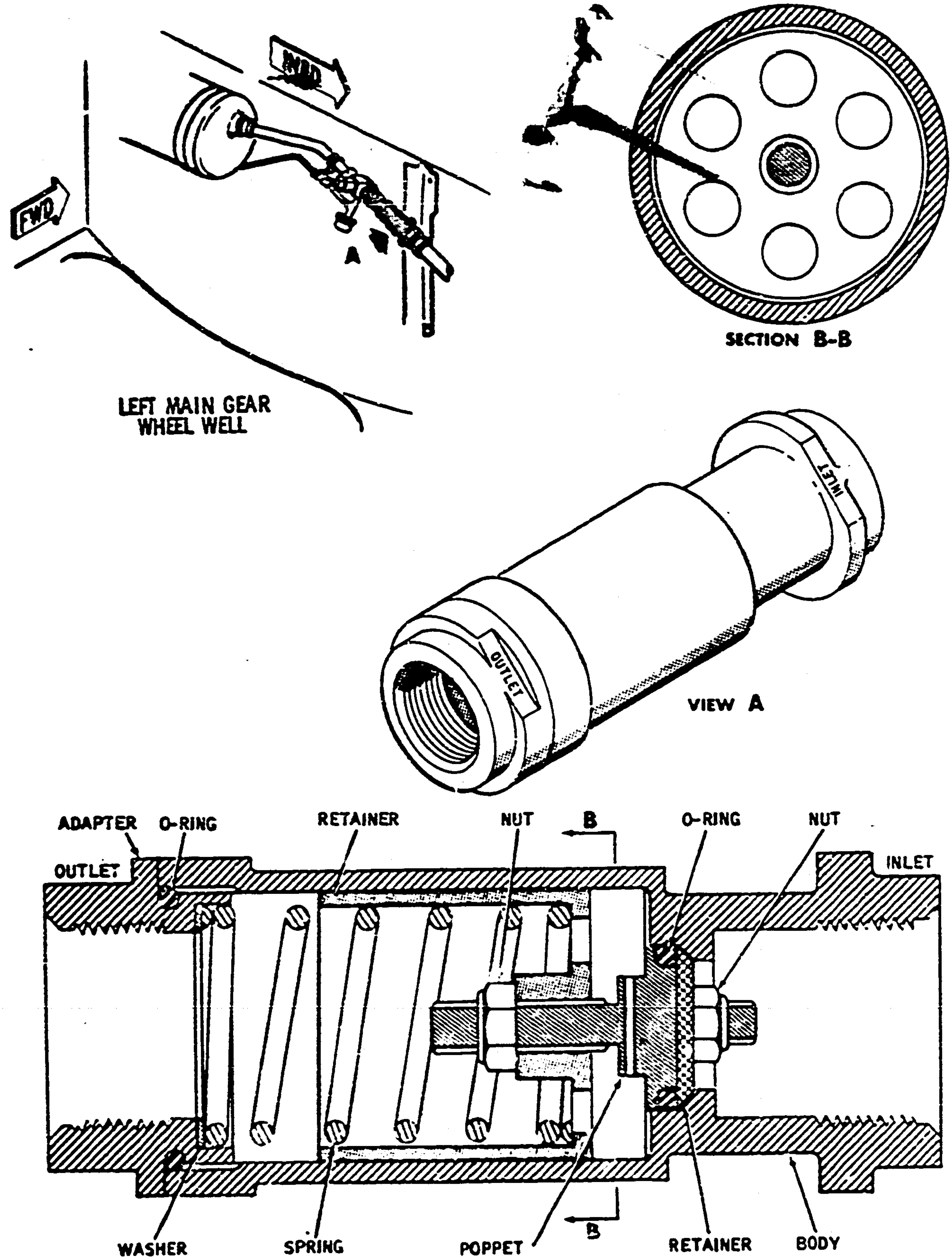
(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.



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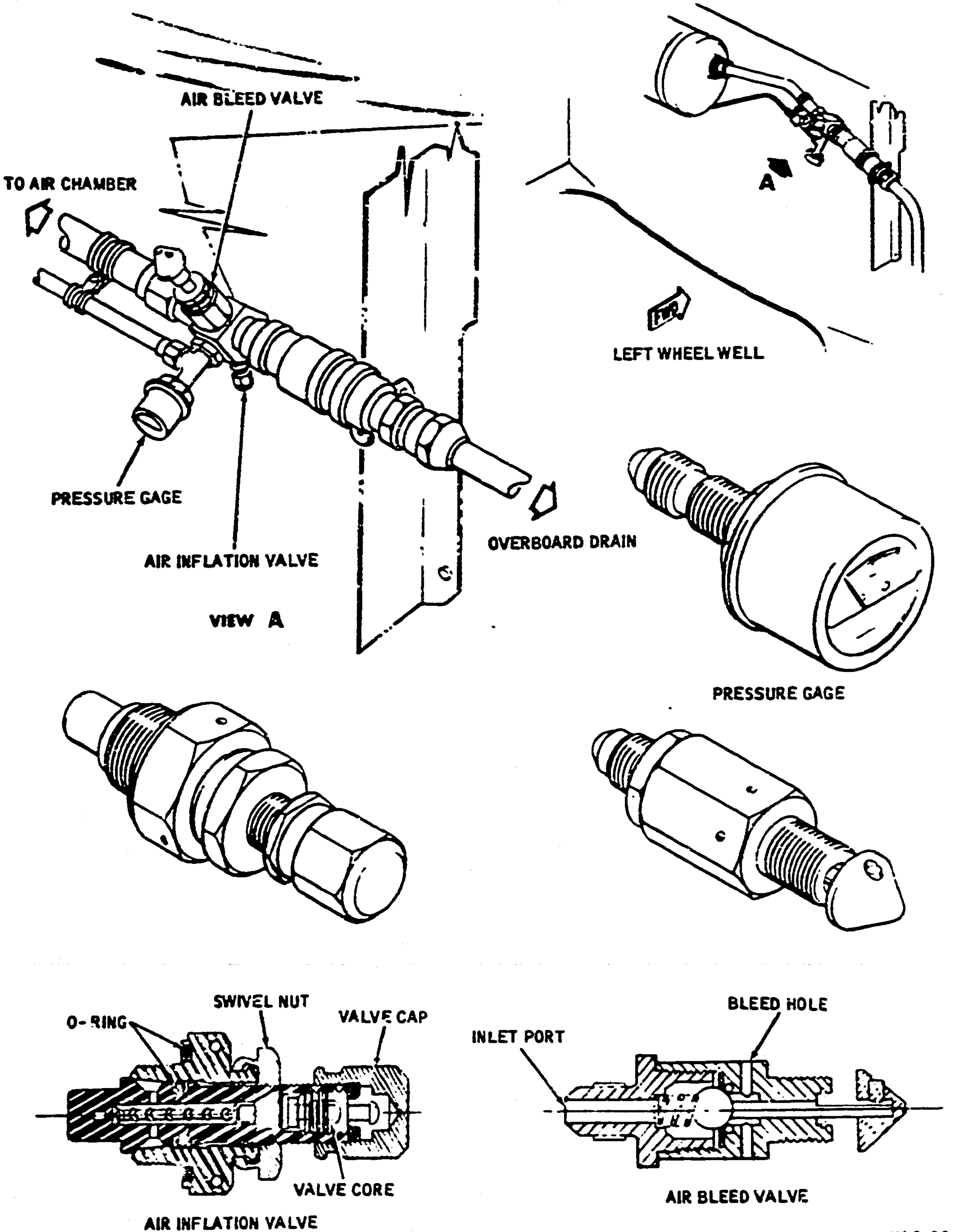
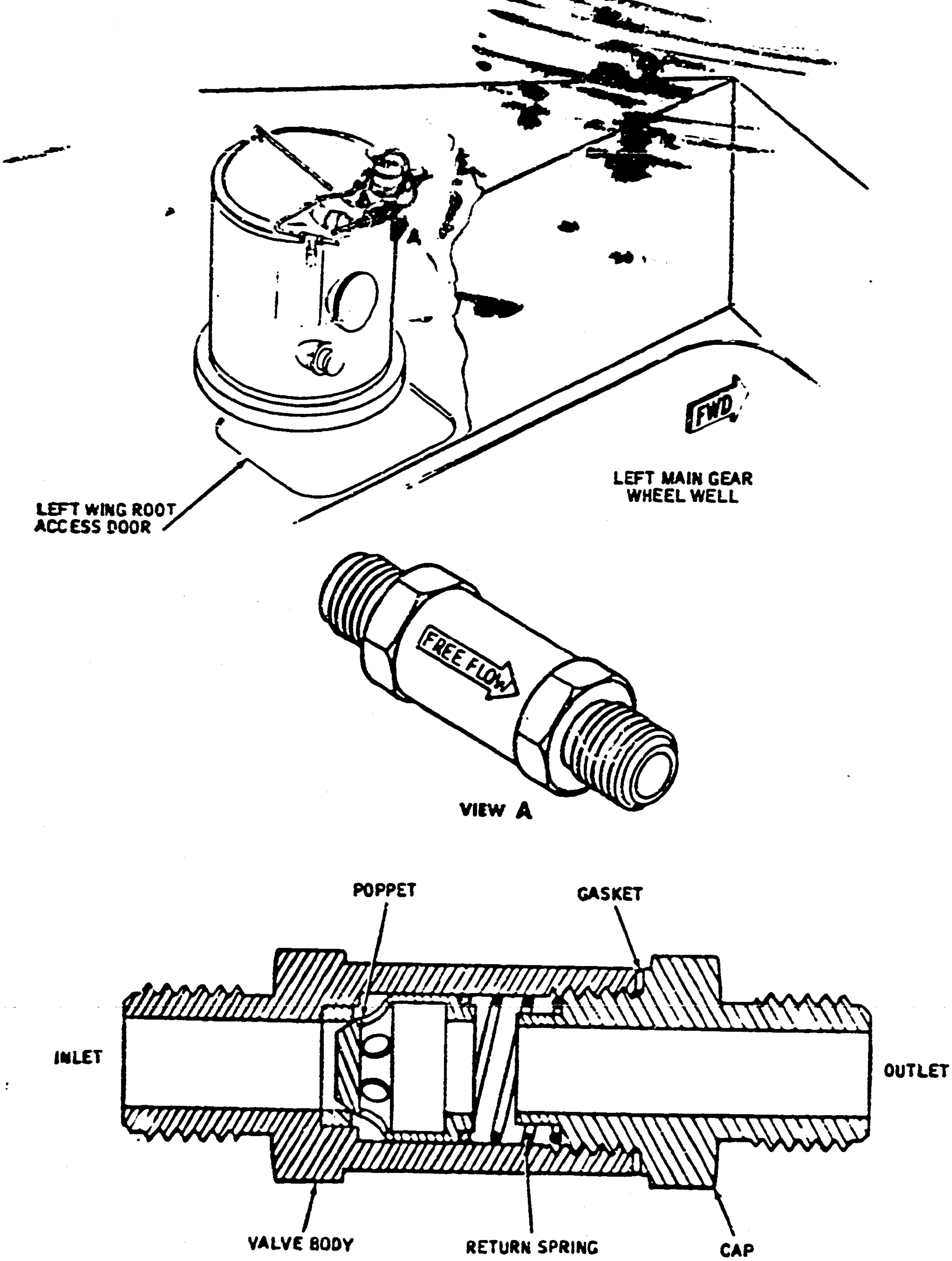
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



HA2-33

Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

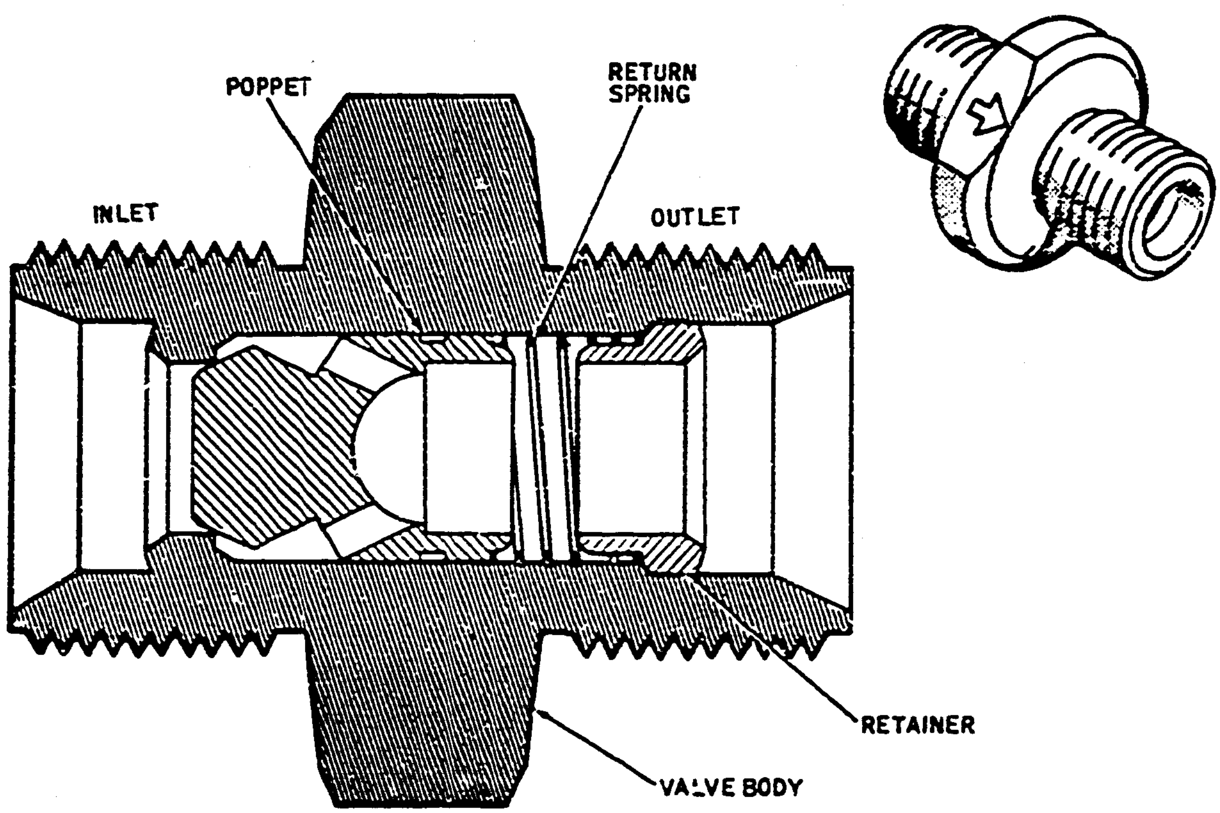
(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

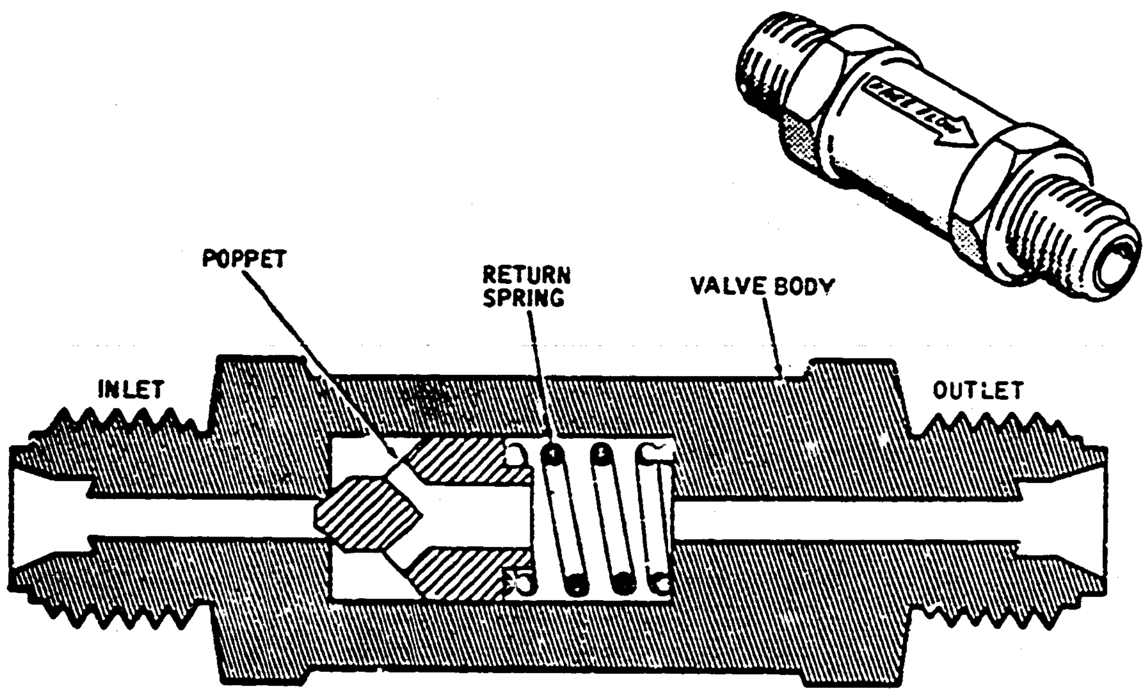
J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.



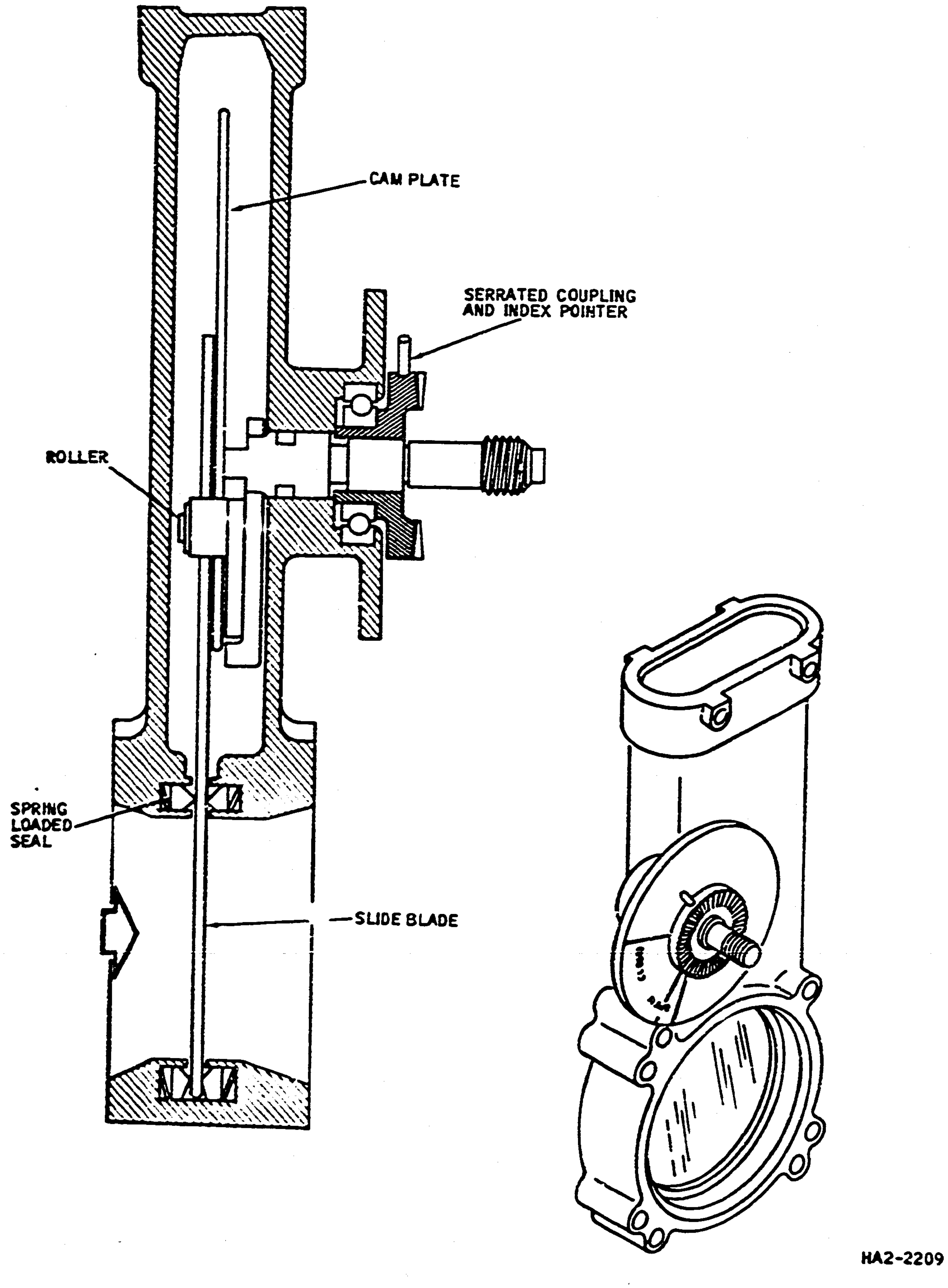
MINIATURE CHECK VALVE



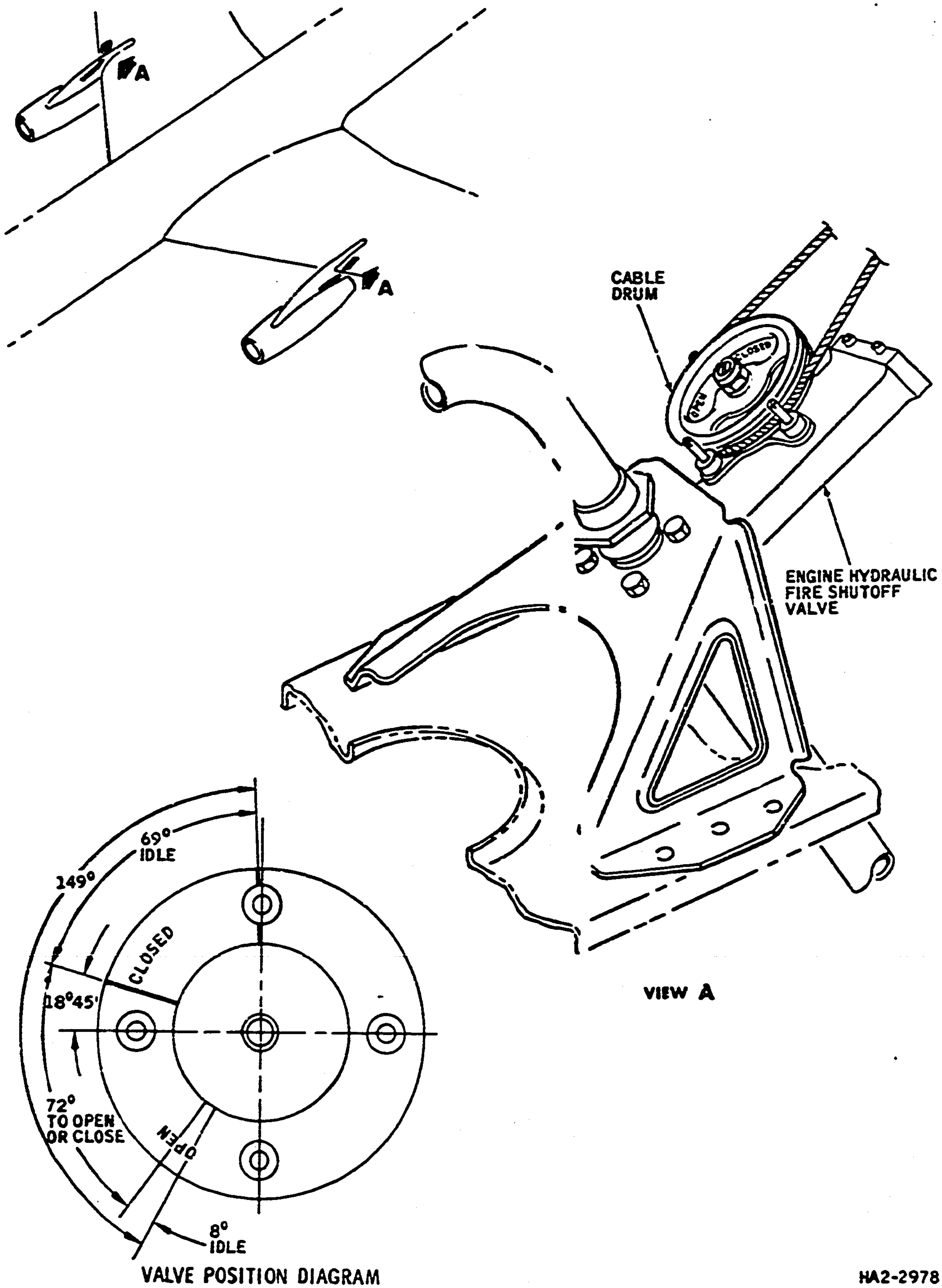
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

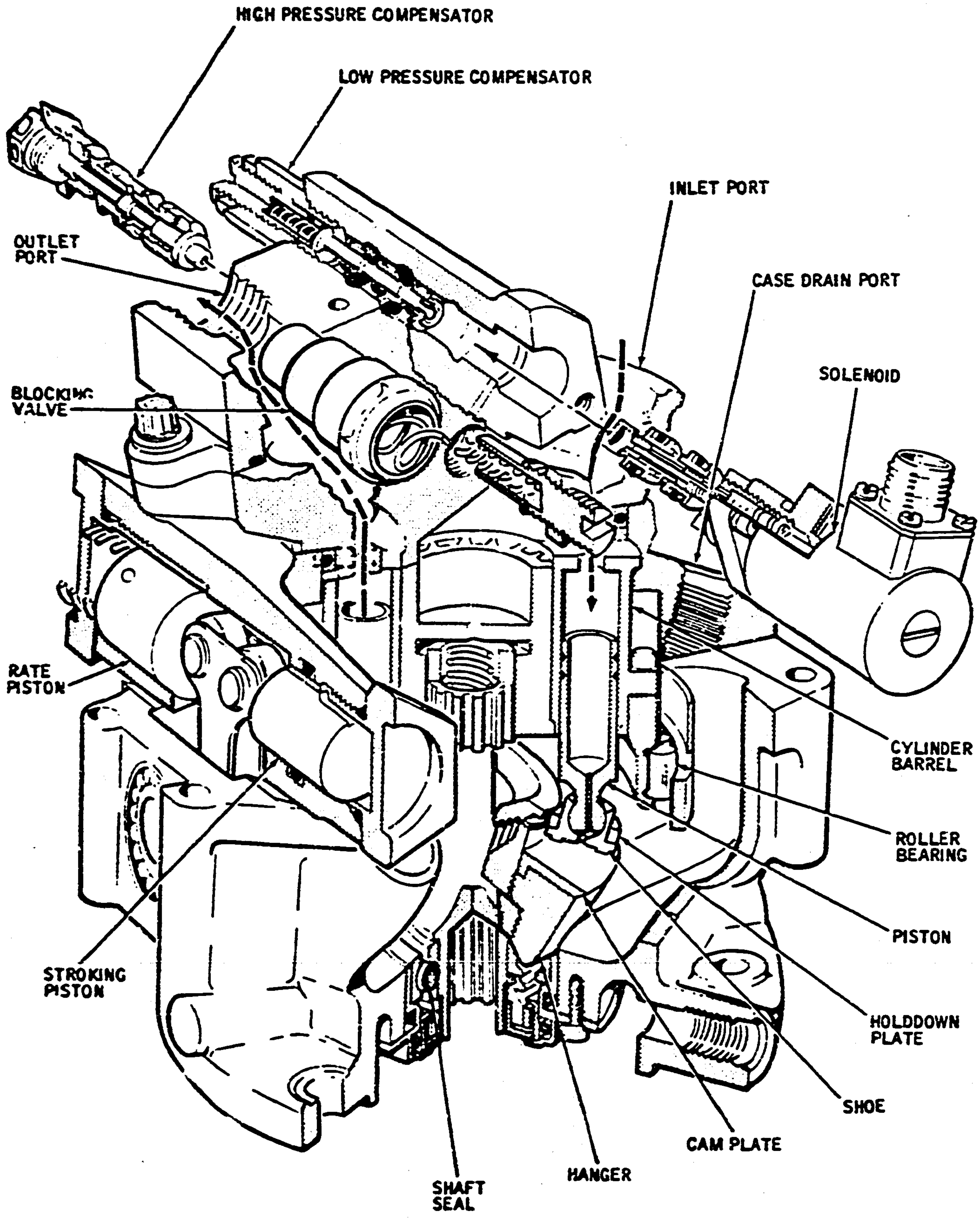
(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

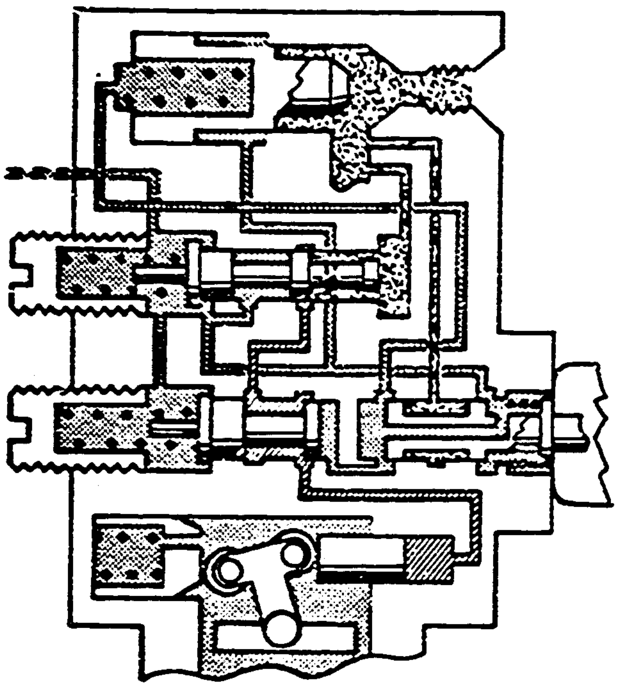
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drums, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figures 13 and 14.)

(1) The two, single-stage, variable-displacement, cam-actuated, pressure-compensated, engine-driven hydraulic pumps are installed, one each, on the inboard engines. The pump incorporates a solenoid-operated bypass feature for reducing the output pressure to zero psi. Each bypass valve solenoid is controlled by a corresponding engine hydraulic pump control switch in the flight compartment. The switch for the hydraulic pump on engine 2 is placarded left, on, and bypass. The switch for engine 3 is placarded right, on, and bypass. When a switch is placed in the bypass position, the bypass valve for that pump is actuated and the pump pressure is reduced to zero psi. When the switch is placed in the on position, the bypass valve is open and the pump operates normally in a pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system.

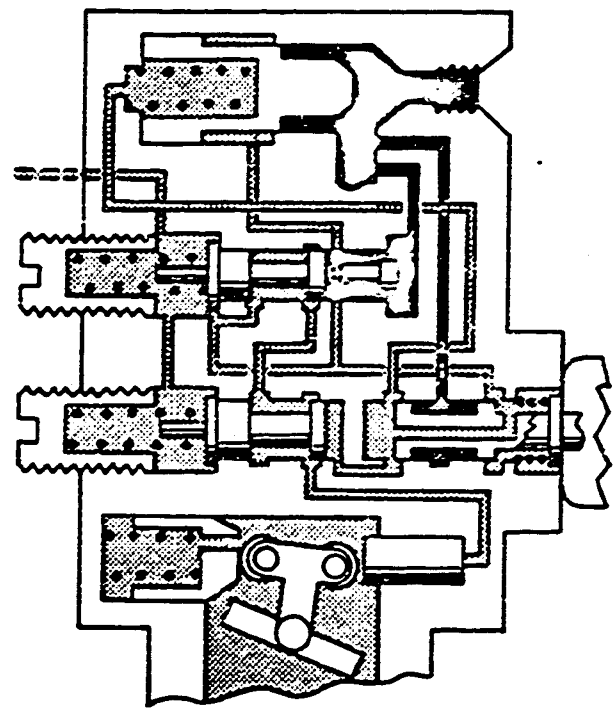


Engine-Driven Hydraulic Pump -- Cutaway View
Figure 13



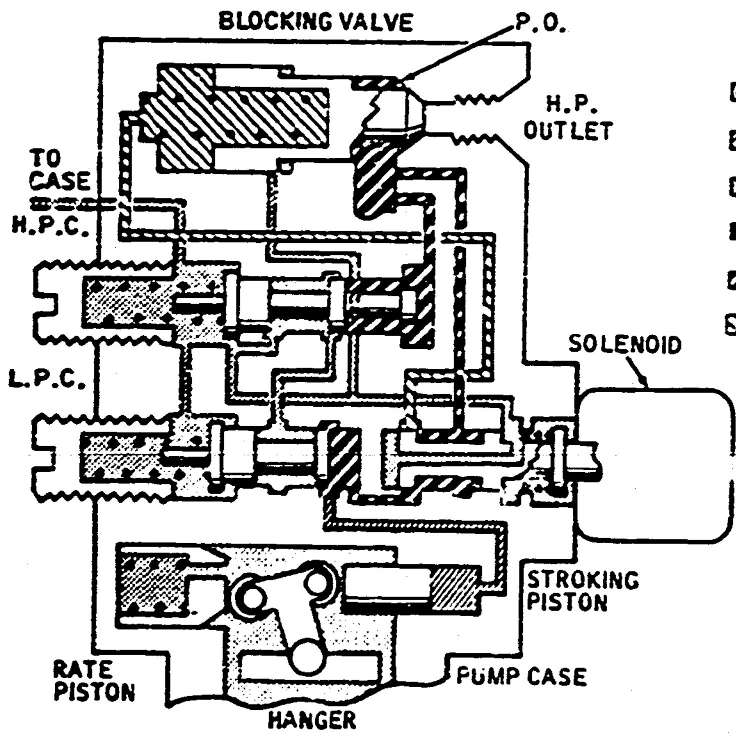
A. FULL PRESSURE, NO FLOW CONDITION

BLOCKING VALVE OPEN, 3,000 PSI FLUID AVAILABLE, NO DEMAND.



B. FULL FLOW CONDITION

BLOCKING VALVE OPEN. HANGER "ON STROKE" 3,000 PSI FLUID FLOWING FROM PUMP.



C. DEPRESSURIZED AND BLOCKED CONDITION

SOLENOID ENERGIZED, BLOCKING VALVE CLOSED, PUMP COMPENSATED AT 500 PSI.

KEY

- COMPENSATED PRESSURE: 3,000 ± 50
- CONTROL PRESSURE: 200-300
- CASE PRESSURE: 45-55
- FULL FLOW PRESSURE: TO 2,950
- DEPRESSURIZED PRESSURE: 400-500
- BLOCKING VALVE PRESSURE: 400-500

P.O. = PUMP OUTLET
H.P.C. = HIGH PRESSURE COMPENSATOR
L.P.C. = LOW PRESSURE COMPENSATOR

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Engine-Driven Hydraulic Pump Pressure Flow -- Schematic
Figure 14

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(2) The heart of the pump is a revolving cylinder barrel which contains nine pistons. By means of a hold-down plate and hydraulically balanced shoes, the pistons are supported on an inclined cam plate which causes them to reciprocate as the barrel revolves. The hold-down plate ensures positive stroking of the pistons during the suction stroke. The angle of the cam plate is varied by moving the trunnioned hanger on which it is mounted, thereby changing the displacement of the pump. The hanger, in turn, is controlled by a pressure compensator.

(3) Oil passes through the main inlet and then through porting in the end of the cylinder barrel to the cylinders from which the pistons are being withdrawn. As the cylinder barrel revolves, these pistons are forced into their bores and discharge high-pressure oil through porting in the end of the barrel to the outlet port.

(4) The cylinder barrel, supported by a radial bearing, is driven by an internal shaft which passes through the trunnioned hanger. A hydraulically balanced, face-type, carbon shaft seal is used to assure optimum sealing. Sealing pressure increases as case pressure increases, and the seal adjusts itself to compensate for any wear which takes place.

(5) The pressure compensator regulates the volume delivered in accordance with the demand of the system and maintains the predetermined pressure. When the pressure is less than the spring load, the spring moves the spool to vent oil in the stroking cylinder to the case. The stroking piston then retracts and a spring load on the hanger moves it to a greater angle and increases the volume pumped. The axial thrust of the pistons against the cam plate during power stroke is balanced hydraulically. Oil, at system pressure, is admitted through holes in the piston and shoe to an undercut area in the face of the piston shoe. The pressure applied to the undercut area, which is slightly less than the piston area, effectively balances the forces so that the shoe is supported on an oil film at all times. Balance is controlled to such a degree that there is no excessive leakage, and high volumetric efficiency is maintained.

(6) The axial thrust of the cylinder barrel is also balanced hydraulically against the port plate.

(7) Because of these features, the axial thrust of the pistons is transferred hydraulically, eliminating the need for antifriction thrust bearings. This increases the reliability factor, if contamination or other adverse conditions exist.

(8) The pump functions as a standard, pressure-compensated pump, when the bypass solenoid is not energized. Energizing the solenoid allows the pump to compensate at a reduced, controlled pressure of approximately 500 psi. Also incorporated in the cap is a blocking valve. The valve shuts off the discharge flow from the pump, when the 500 psi compensating valve takes over as a result of the solenoid being energized. Hence,

depressurizing the pump permits operation with the pump completely feathered at approximately 1/2 drive torque required at 3000 psi. The blocking valve is automatically controlled by the depressurizing valve. When the solenoid is energized, the blocking valve prevents flow from the pump discharge port. When the solenoid is deenergized, the blocking valve automatically opens as the pump builds up pressure to match the system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rates at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 15.)

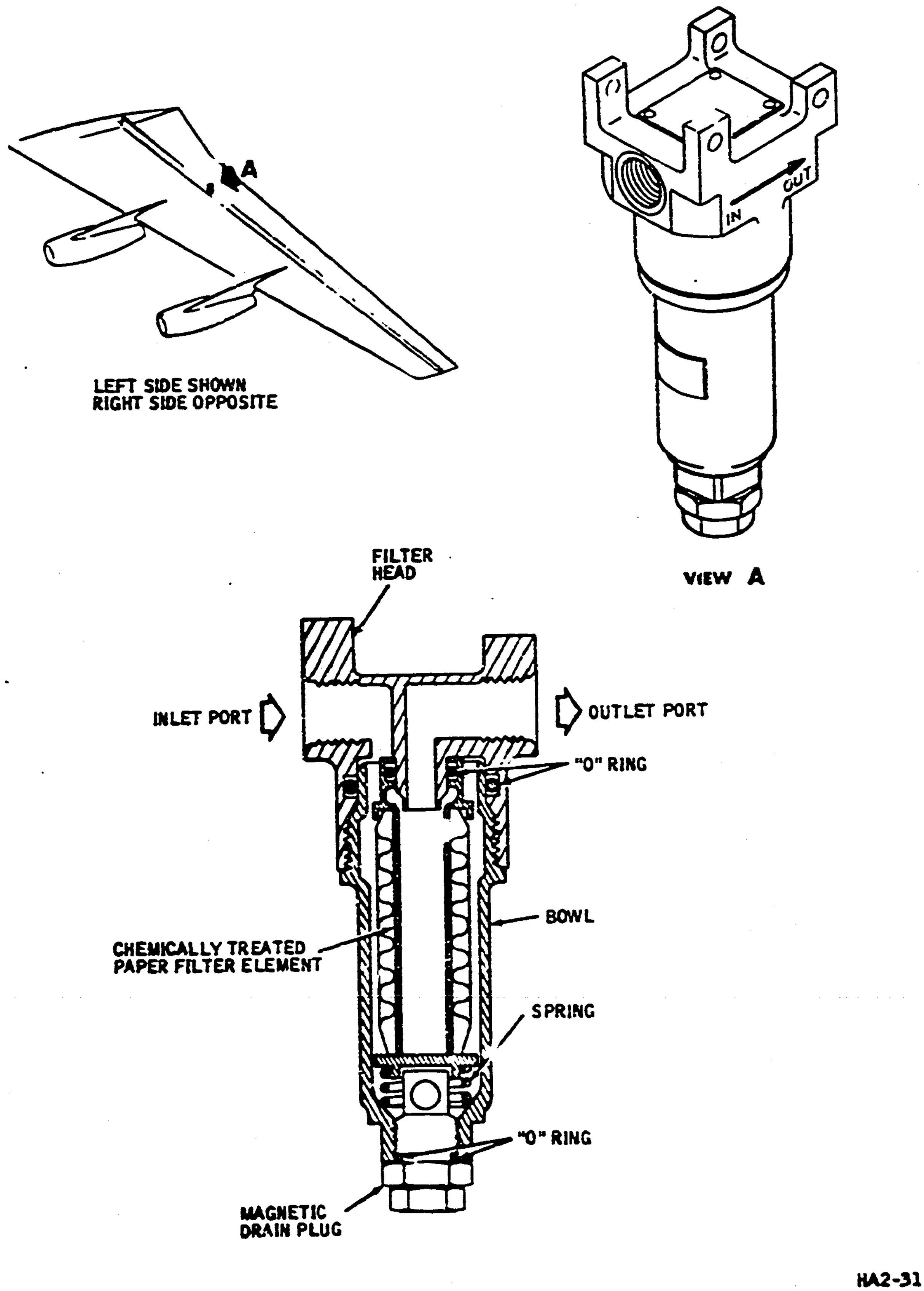
(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

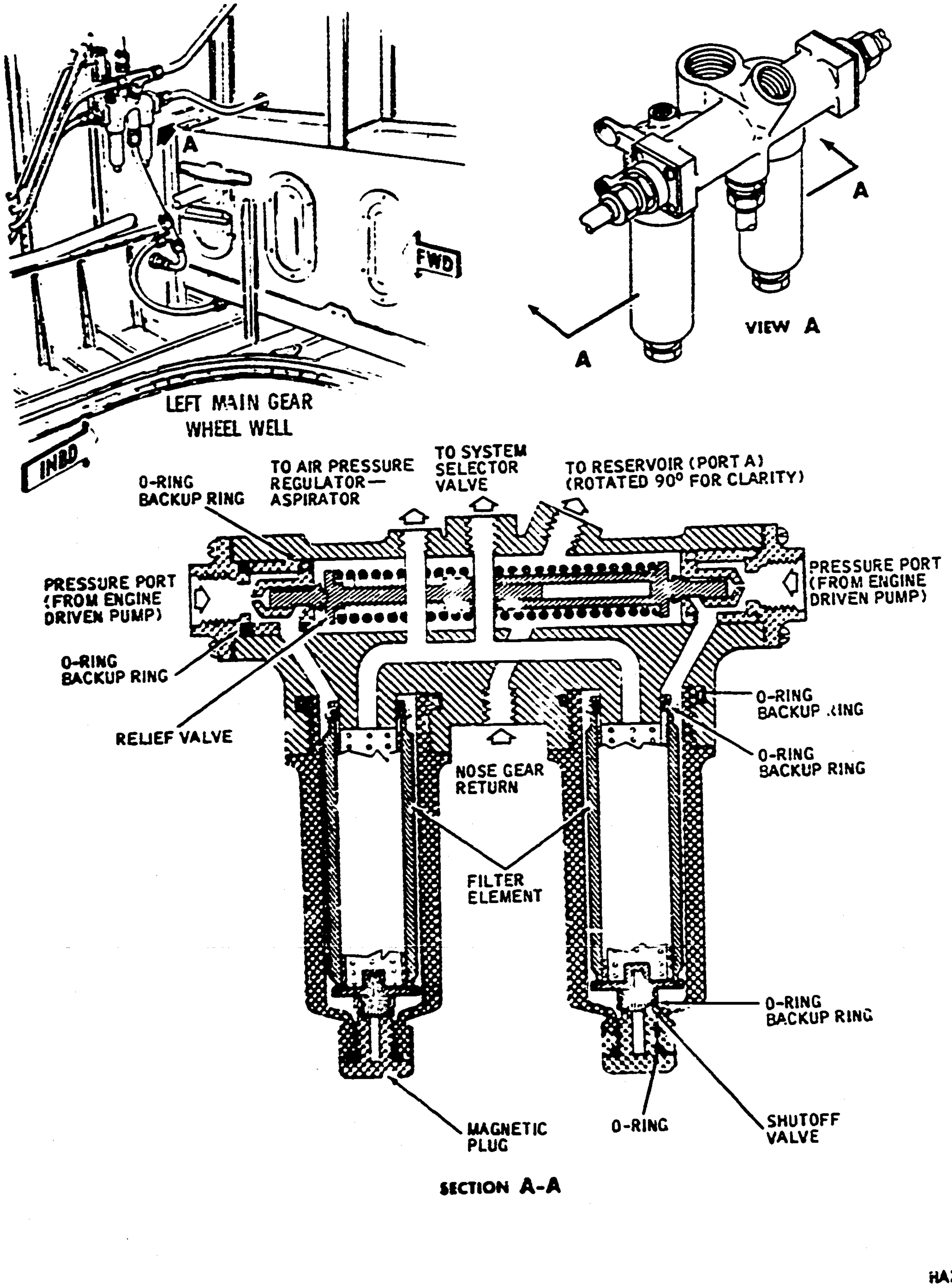
(3) A second line type disposable filter is installed at the case drain port of the engine-driven hydraulic pump.

N. Dual Filter and Relief Valve (See Figure 16.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.



Engine Driven Hydraulic Pump Case Drain Filter -- Cutaway View
Figure 15



Dual-Filter and Relief Valve -- Cutaway View
Figure 16

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

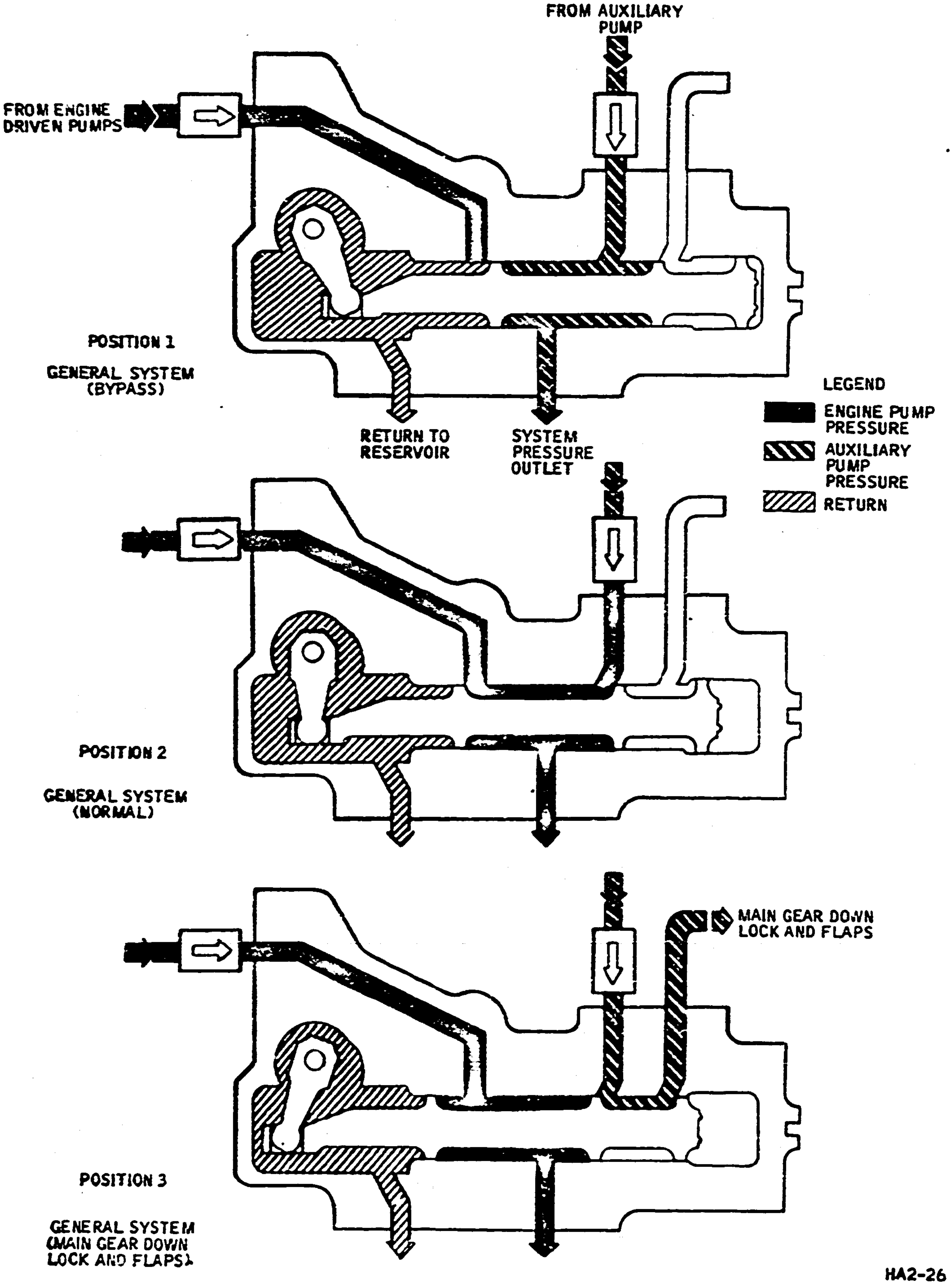
(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 17 and 18.)

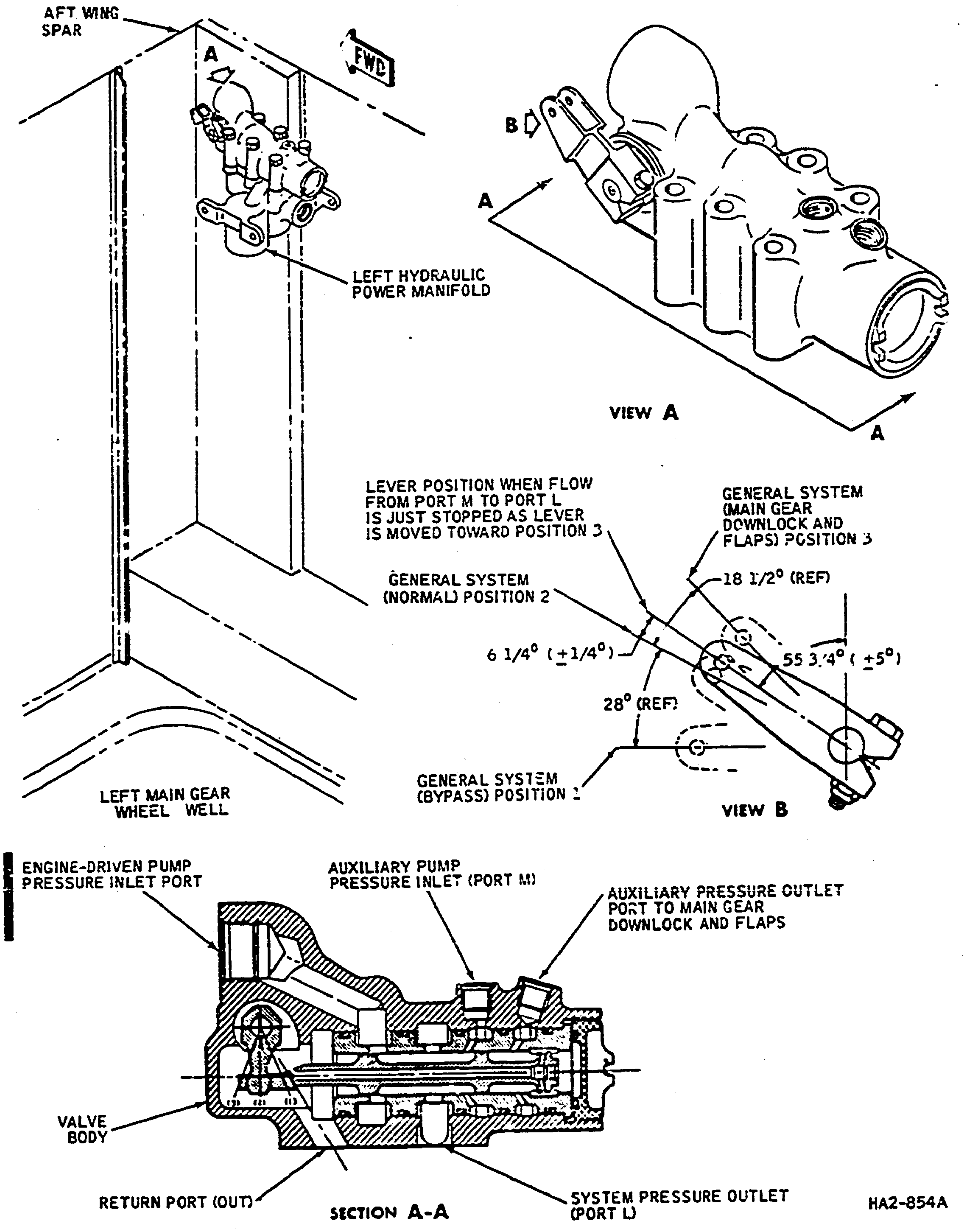
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the



System Selector Valve -- Schematic
Figure 17



System Selector Valve -- Cutaway View
Figure 17

the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 19.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

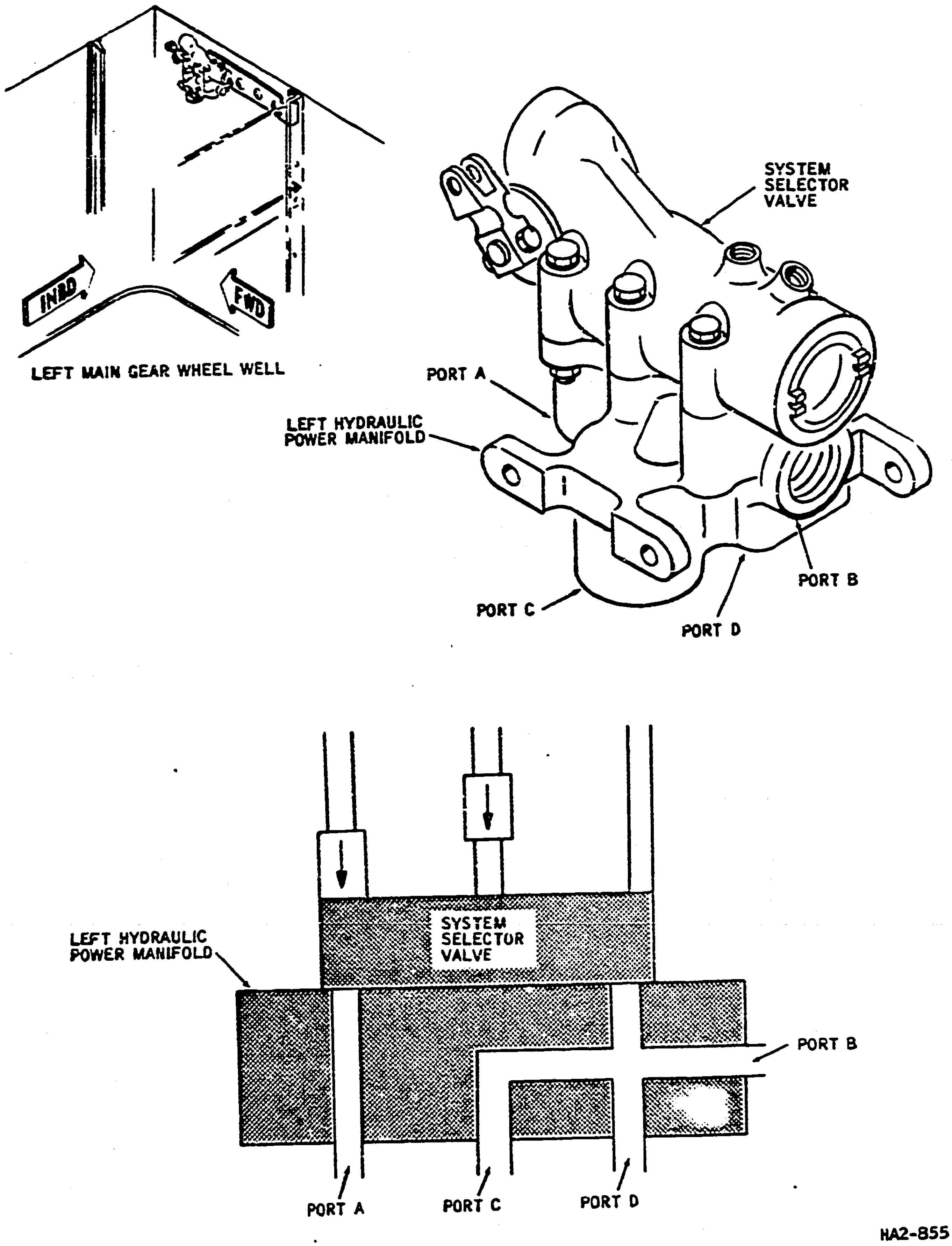
(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

Q. Right Hydraulic Power Manifold (See Figure 20.)

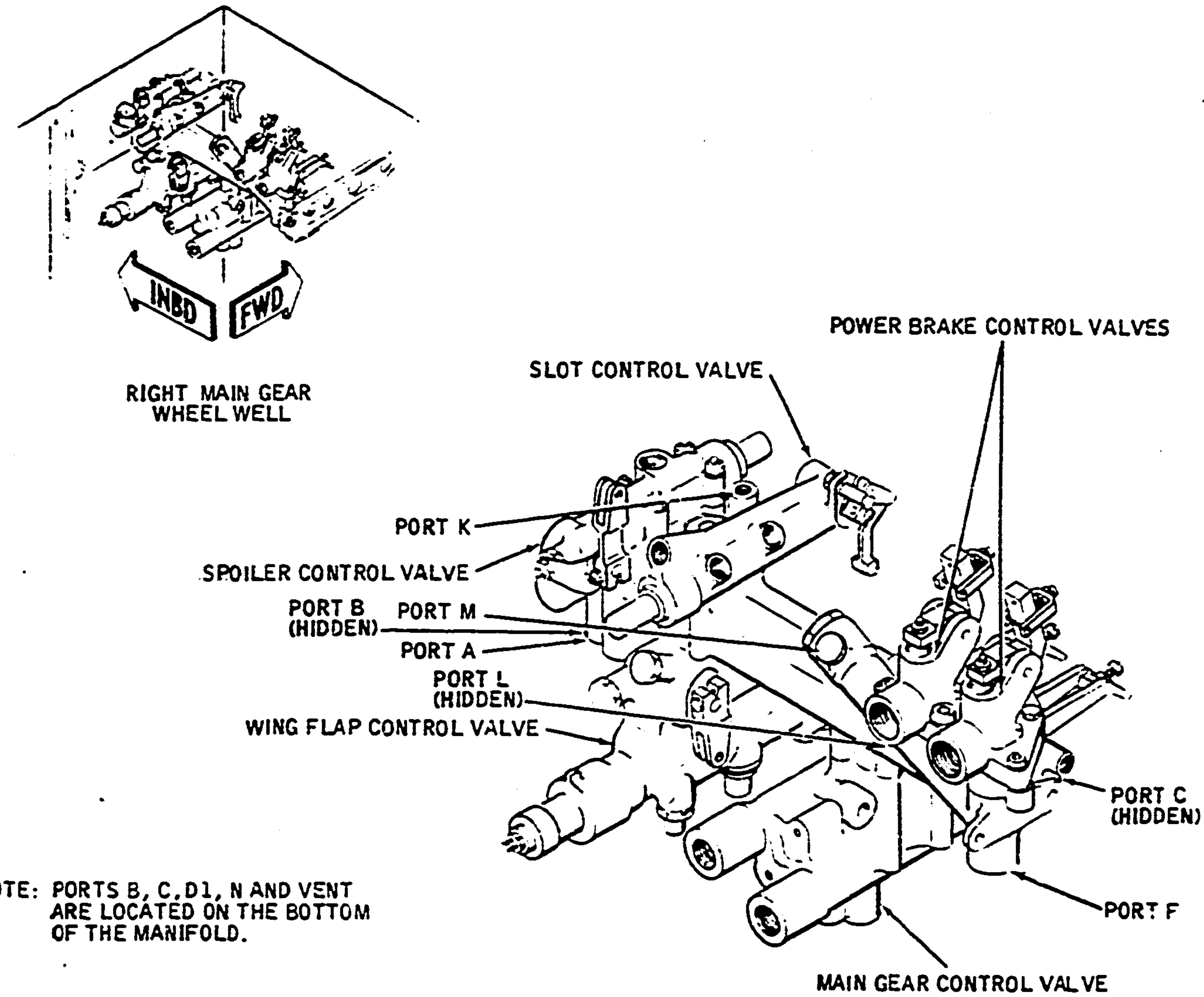
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressures and return lines, and mounting pads for the various control valves.

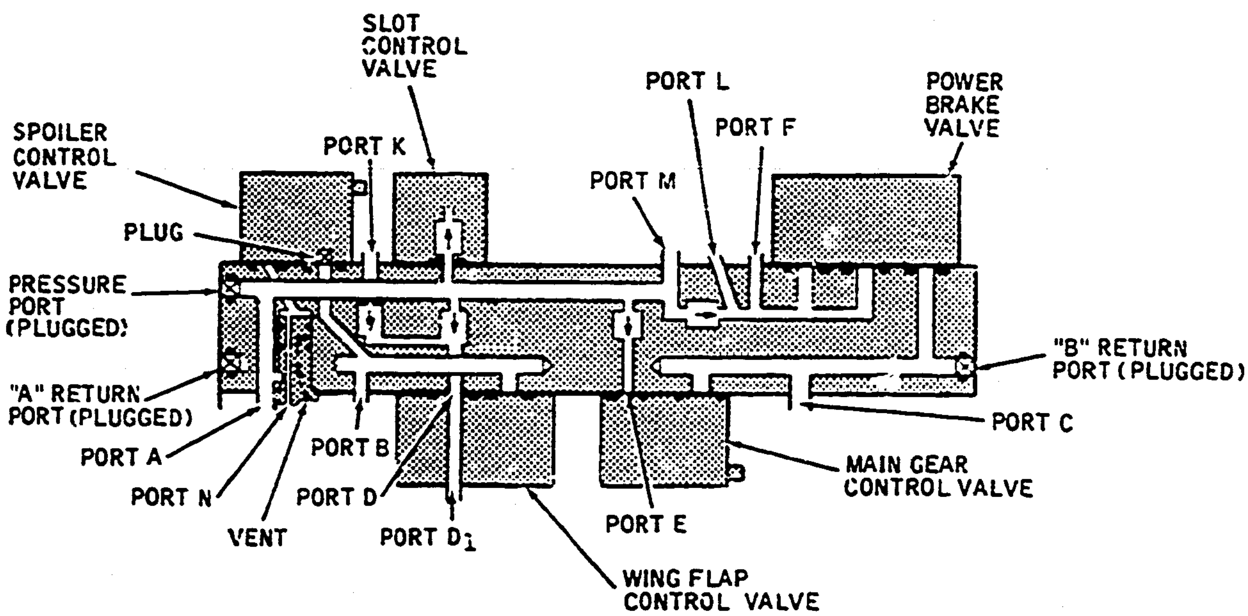
(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.



Left Hydraulic Power Manifold -- Schematic
Figure 18



NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



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Right Hydraulic Power Manifold -- Schematic
Figure 20

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

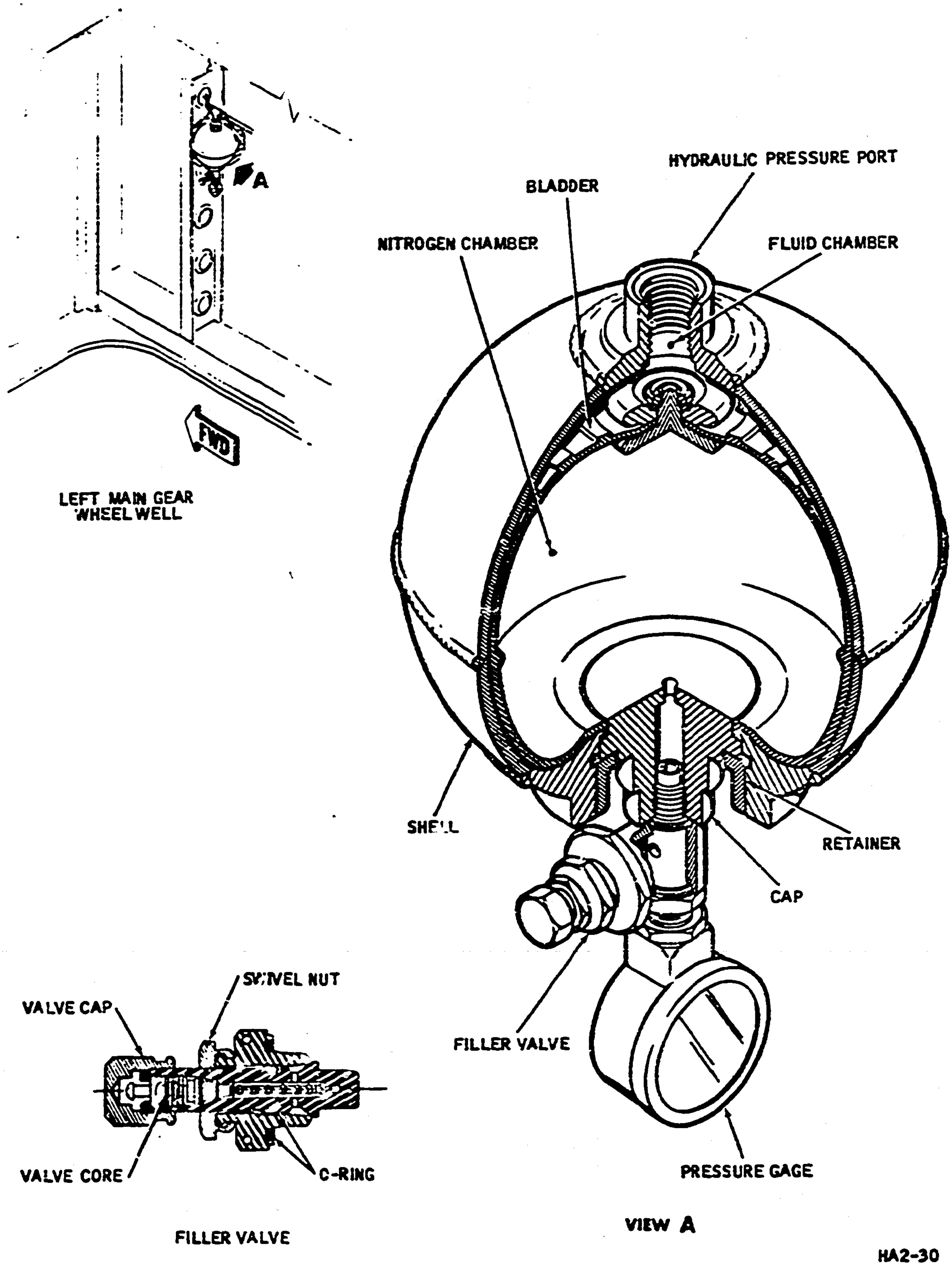
R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 21.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.



Hydraulic Power System Accumulator -- Cutaway View
Figure 21

T. Hydraulic System Priority Valve (See Figure 22.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

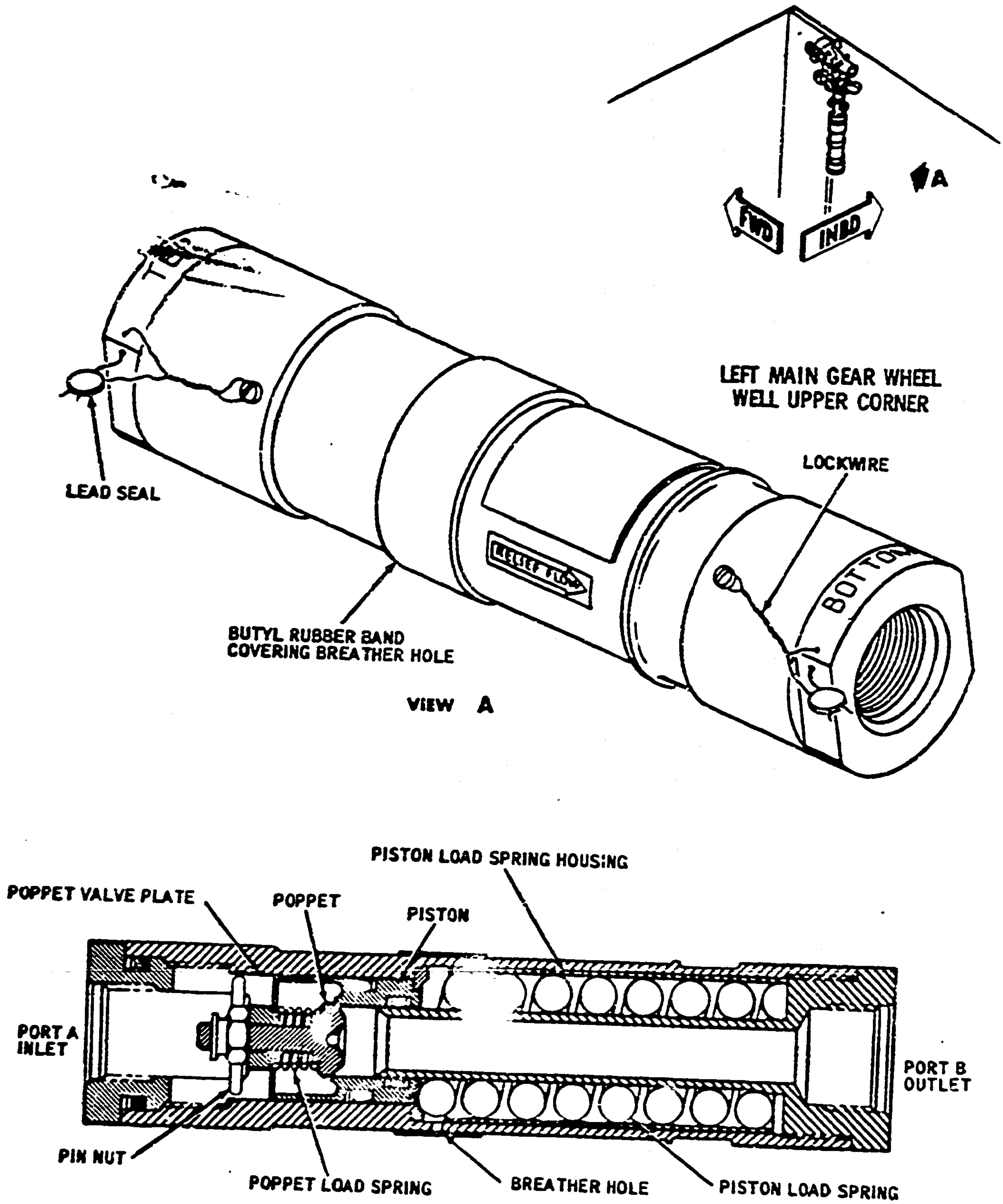
(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)



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Hydraulic System Priority Valve -- Cutaway View
Figure 21

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/ general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

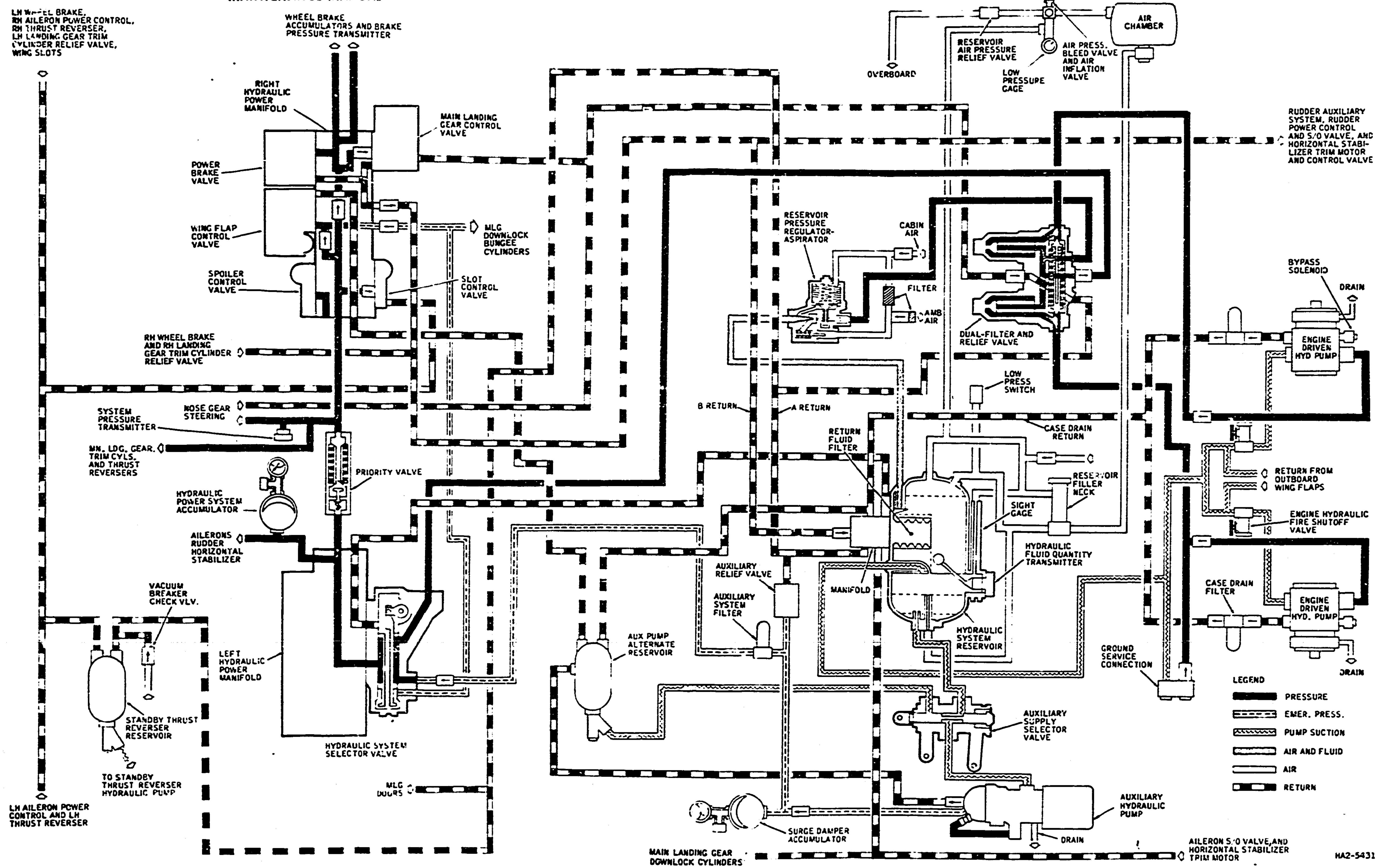
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to



Hydraulic Power System -- Schematic Diagram
Figure 1

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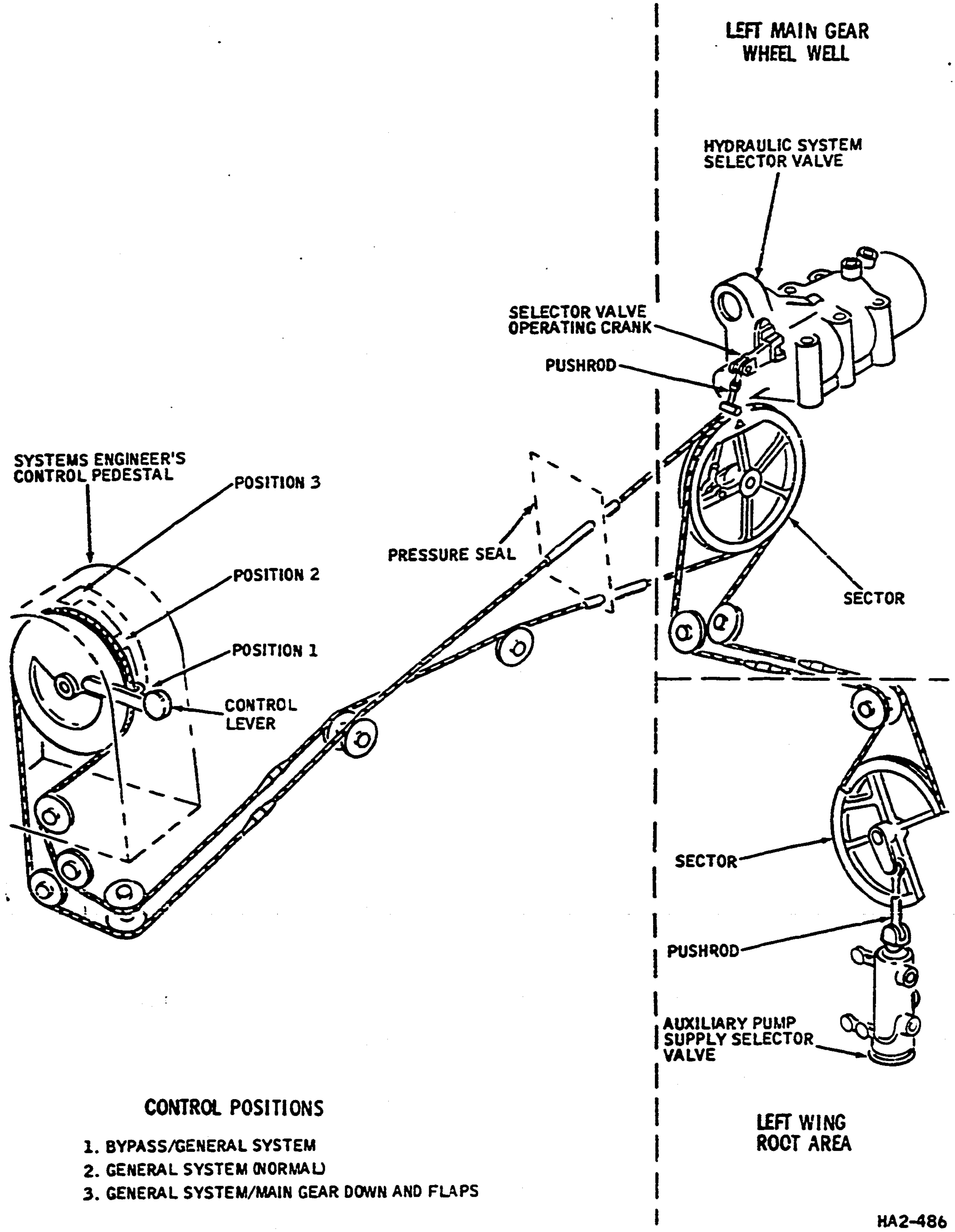


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

the reservoir via the A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff.

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve at each main gear downlock bungee cylinder. When auxiliary pressure is applied, the shuttle valves shift and port fluid into the downlock side of the bungee cylinders.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever and cable drum, the system selector valve sector and system selector valve, and the auxiliary hydraulic pump supply selector valve sector and auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

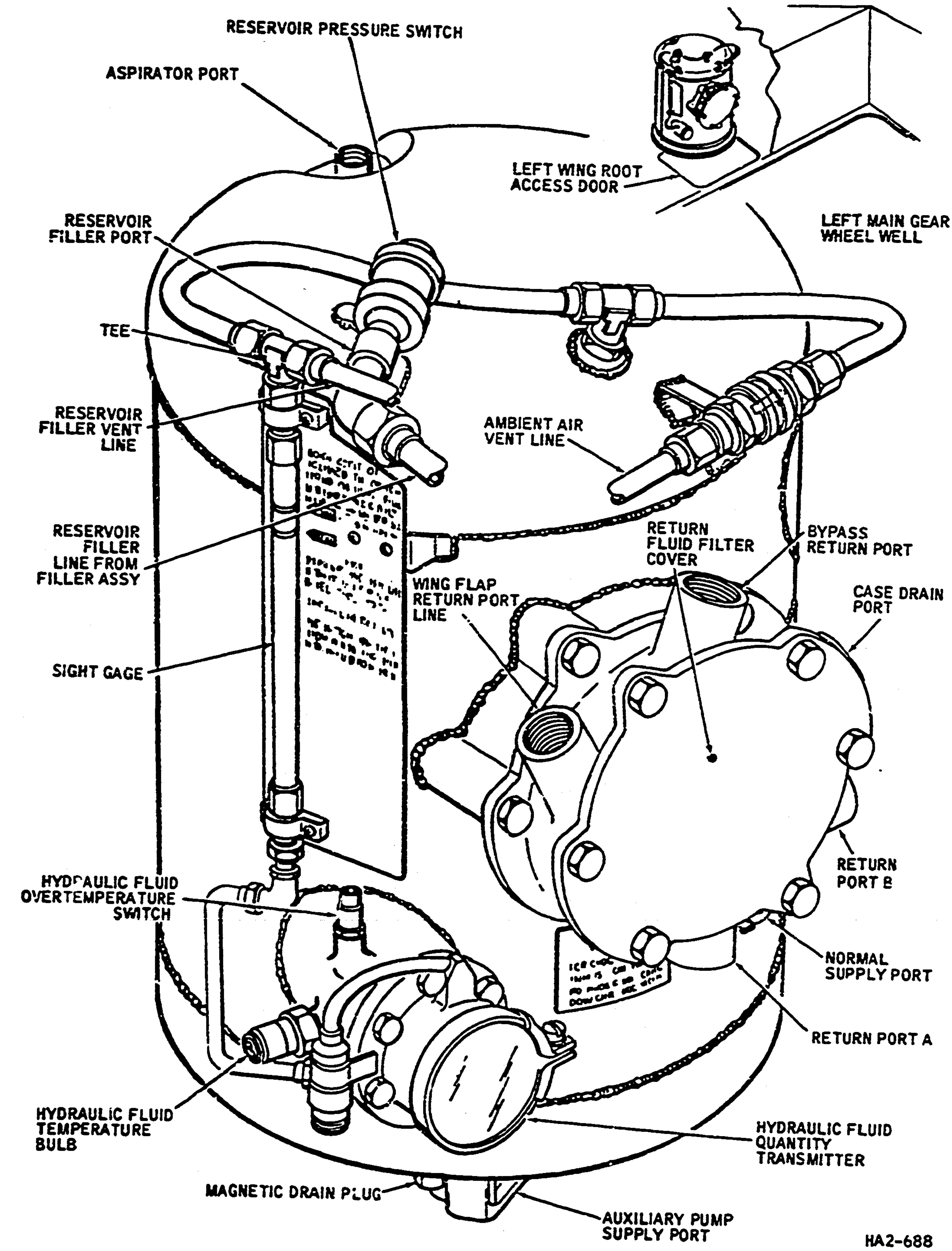
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

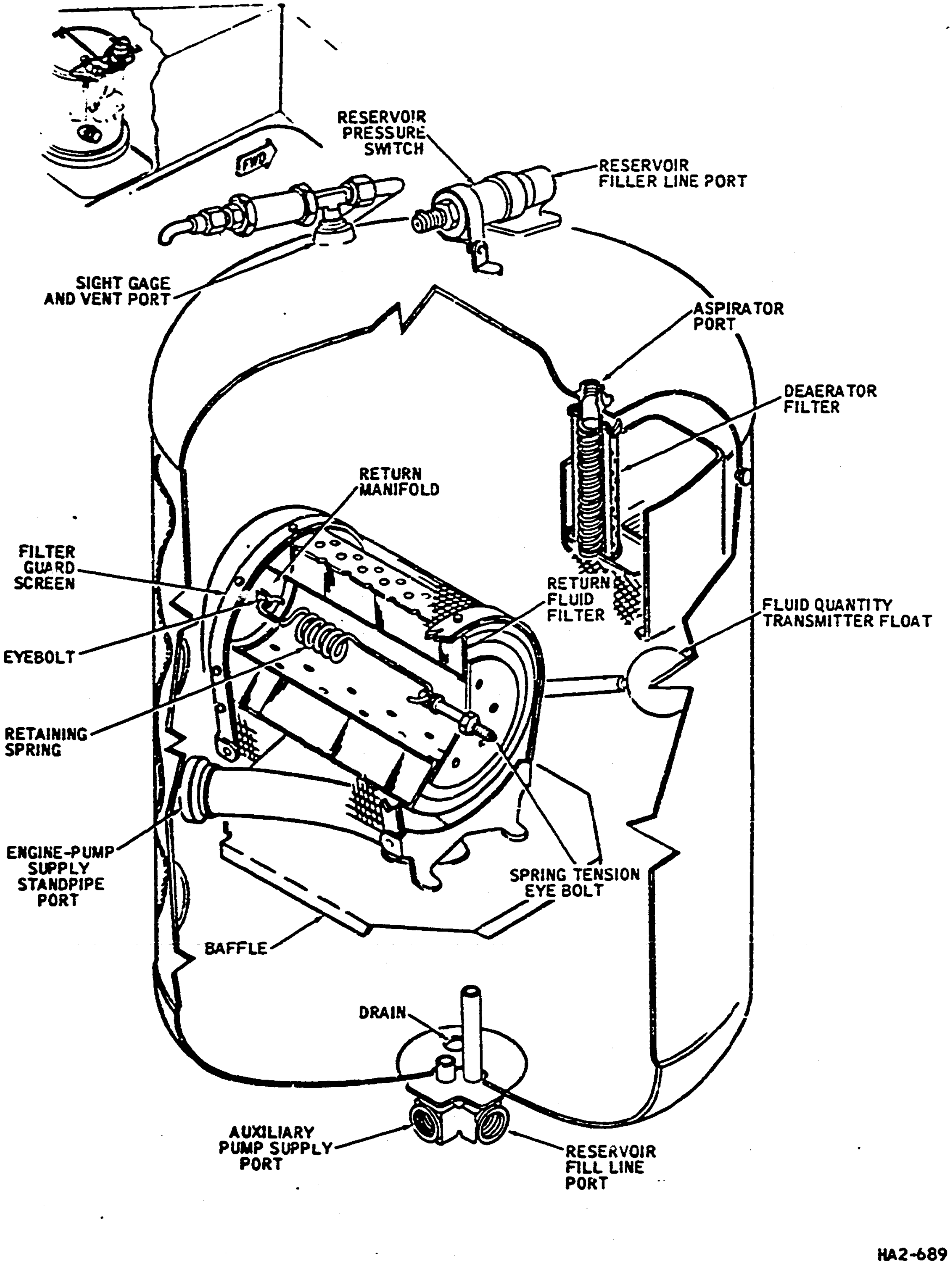
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

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normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to between 30 and 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter is position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

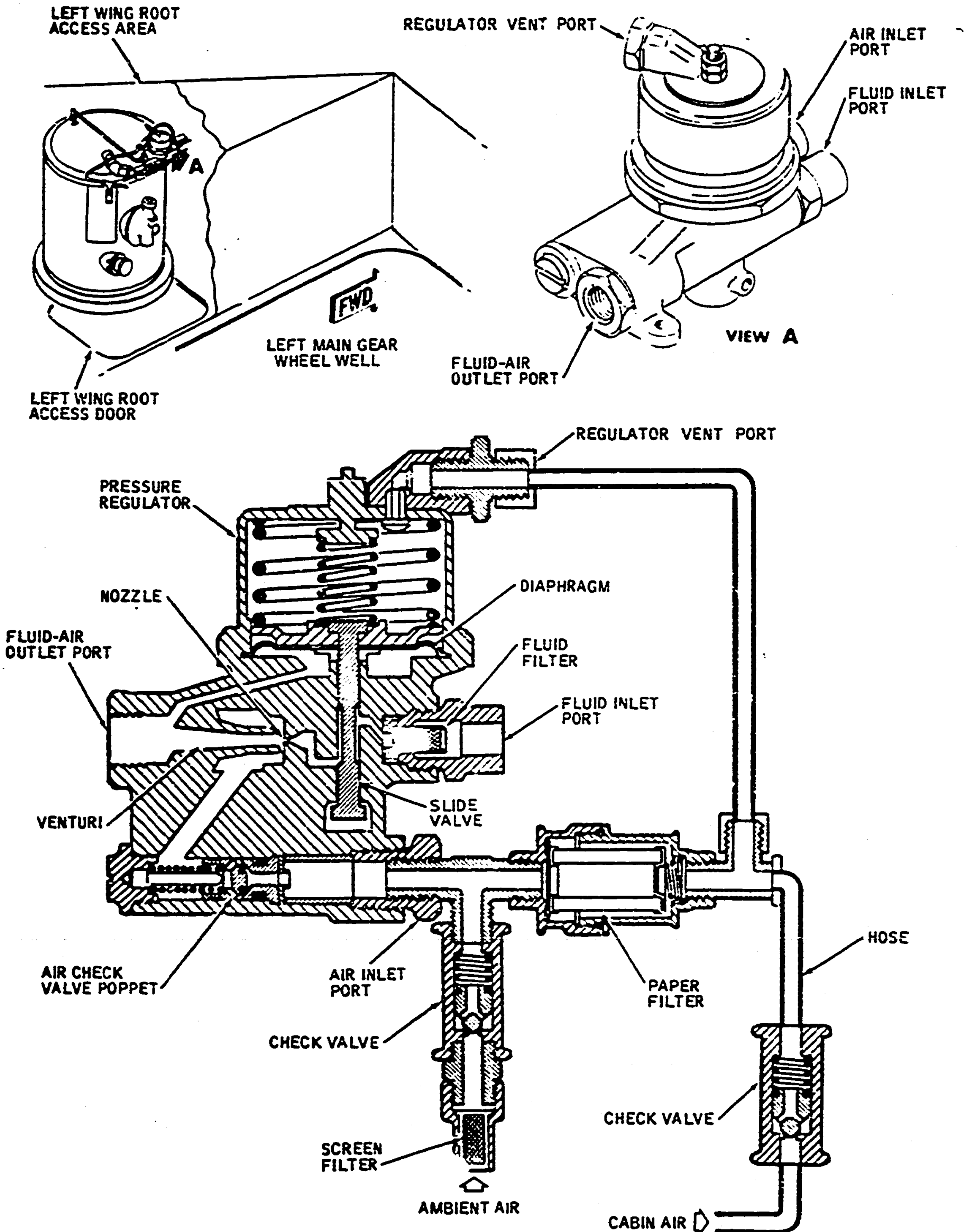
(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

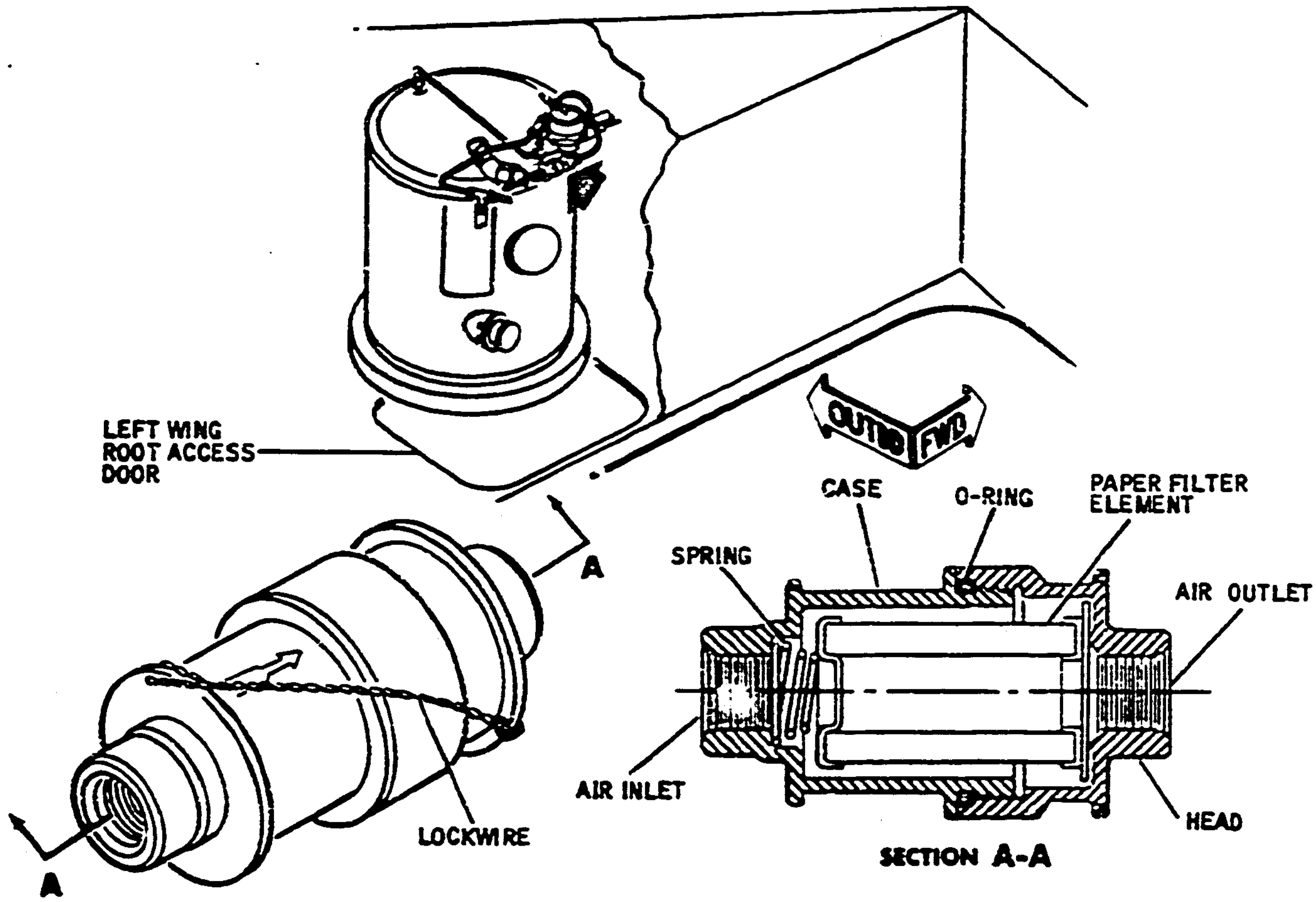
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

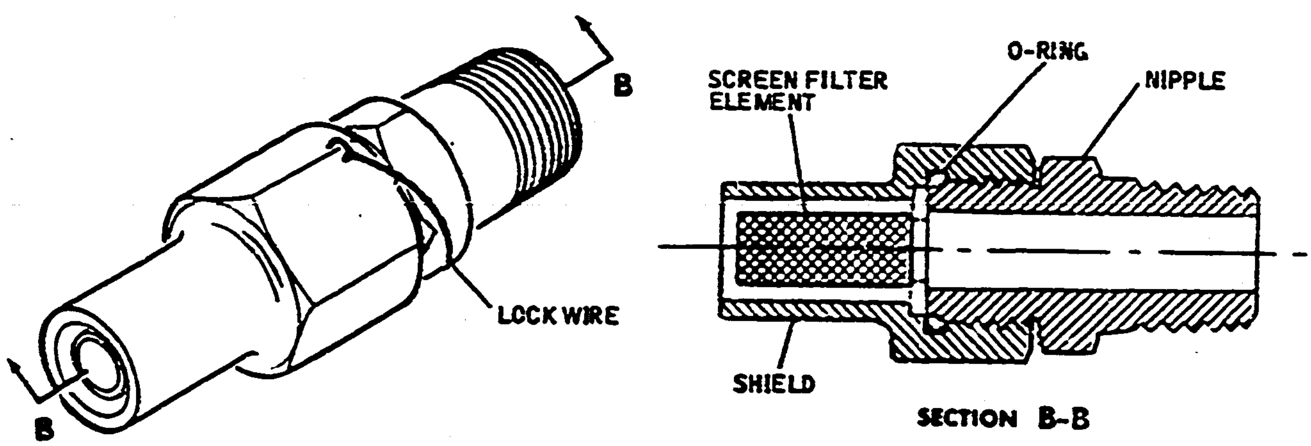
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.



PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the, left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

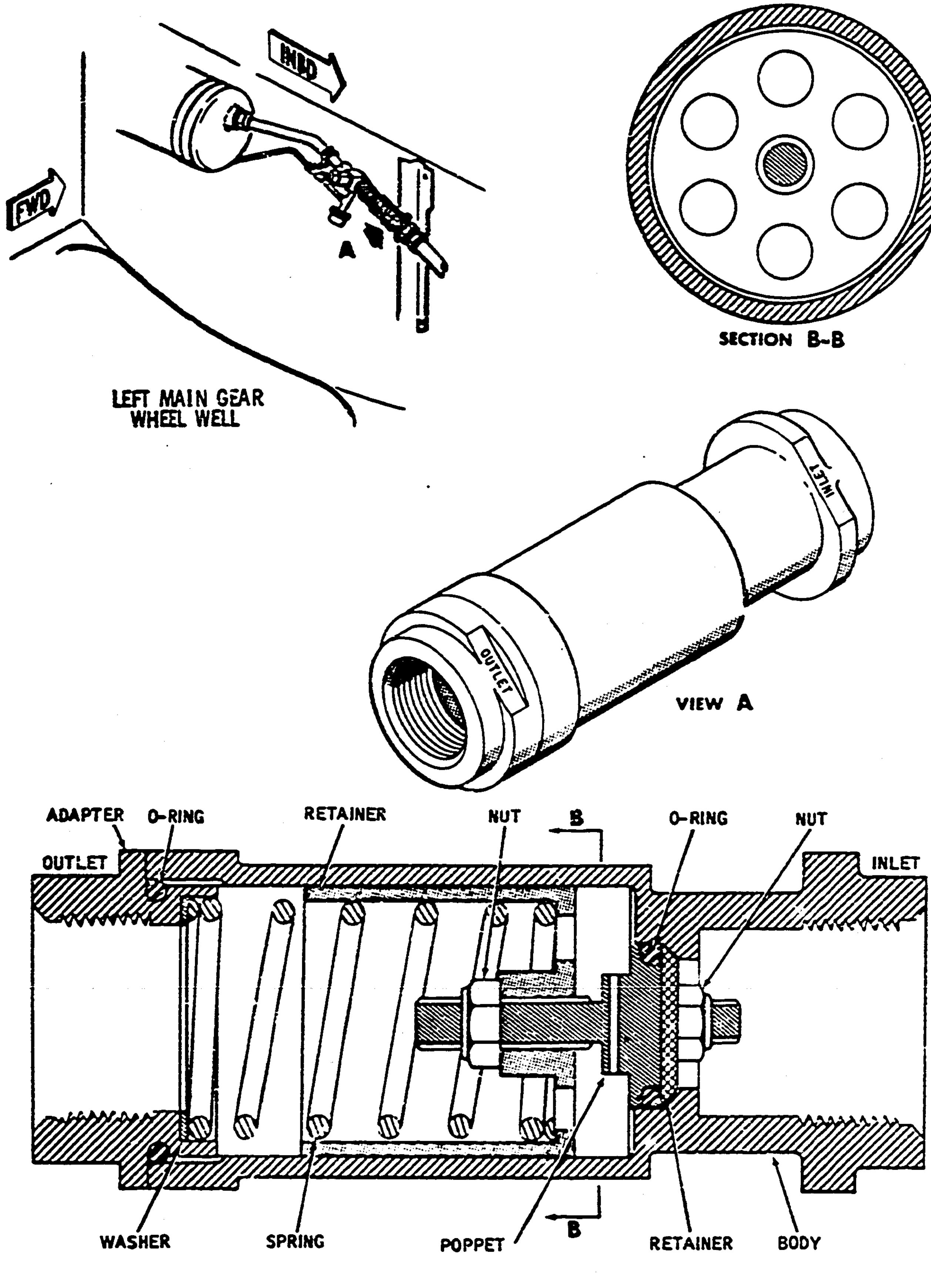
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear



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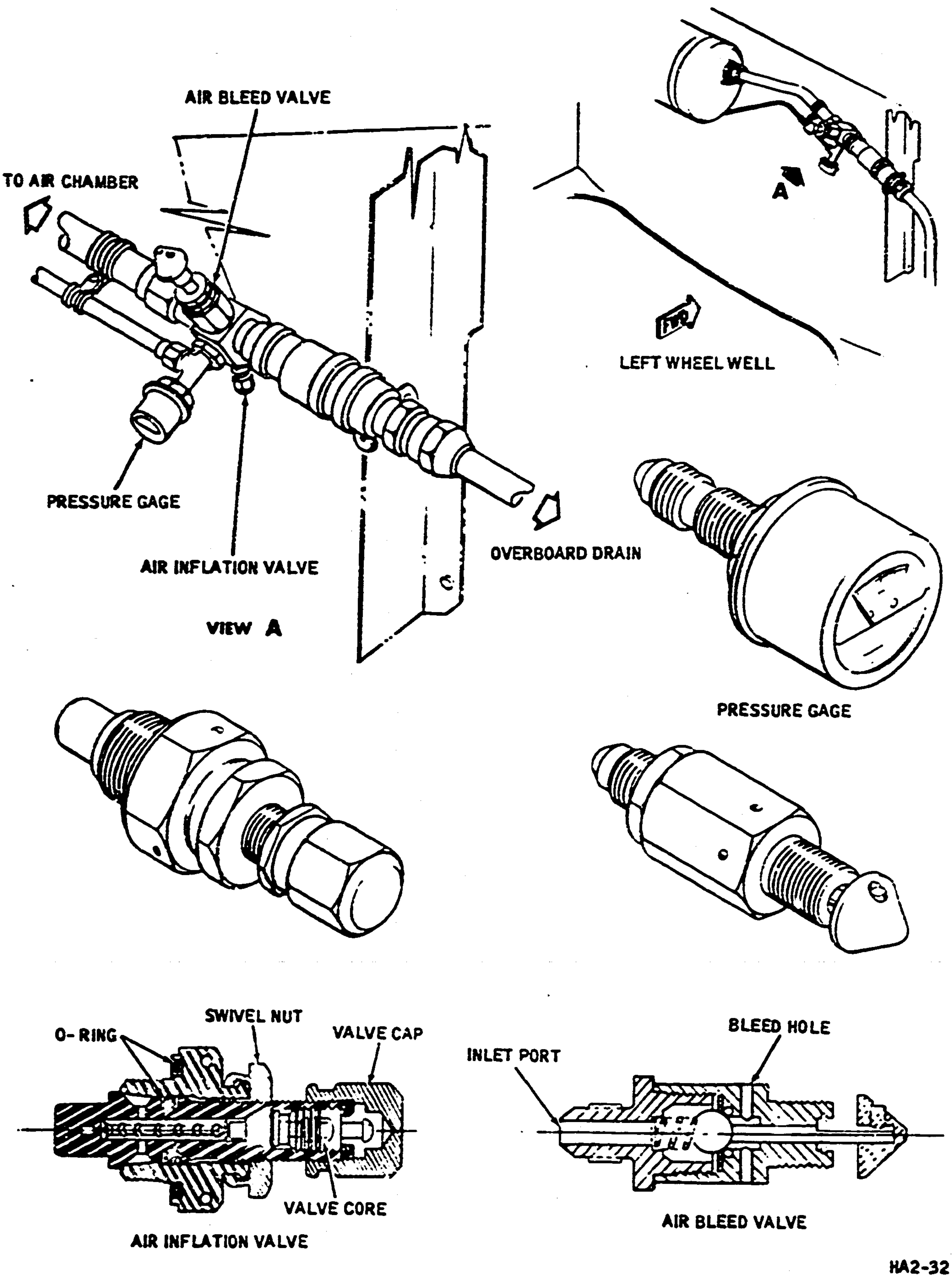
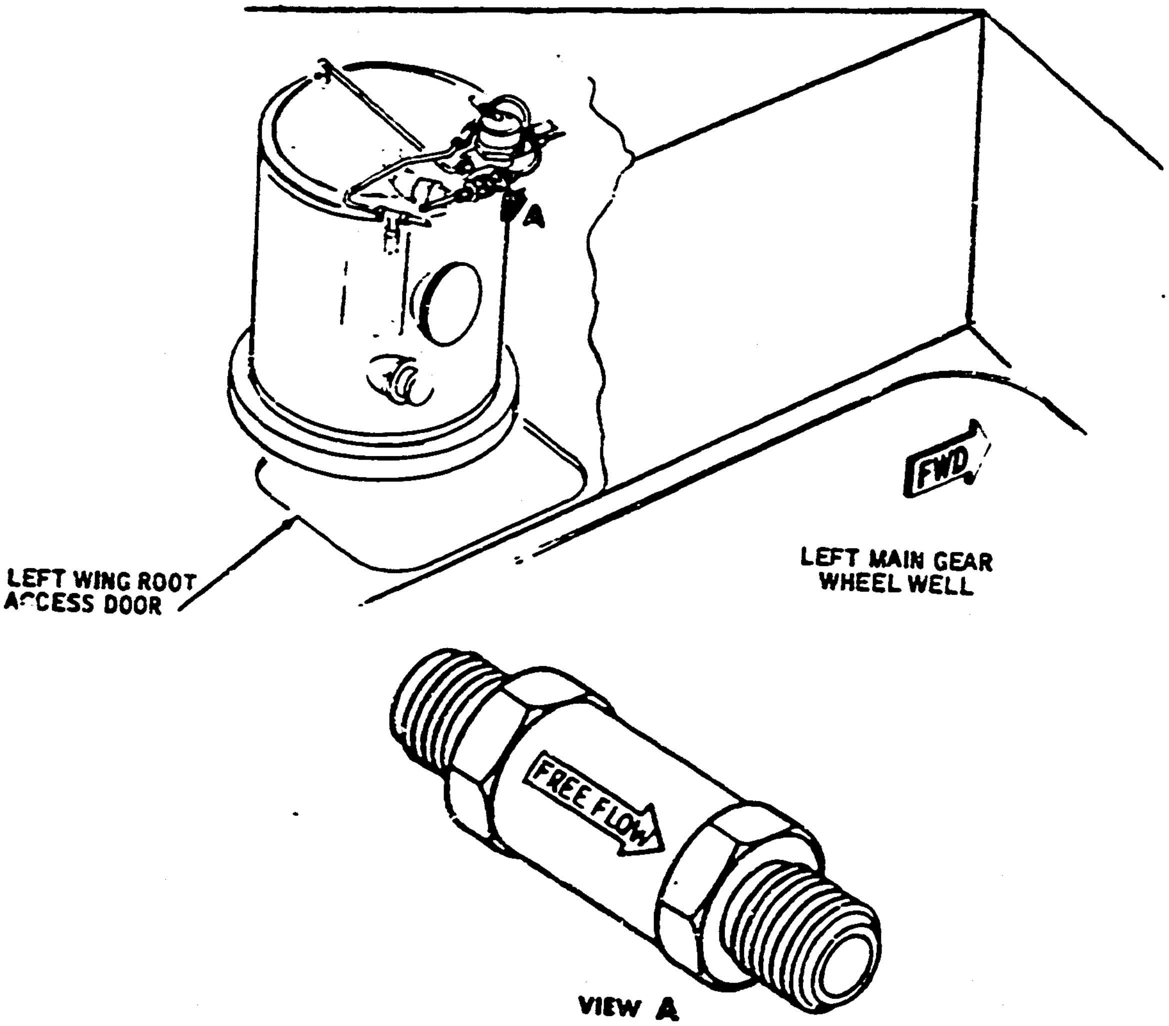
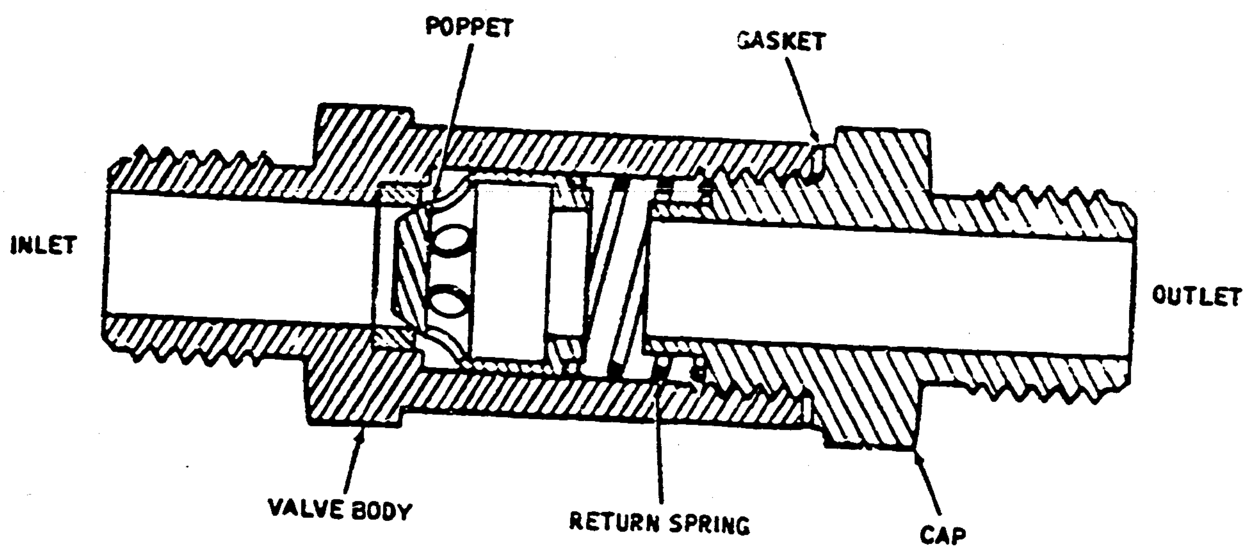
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8





Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

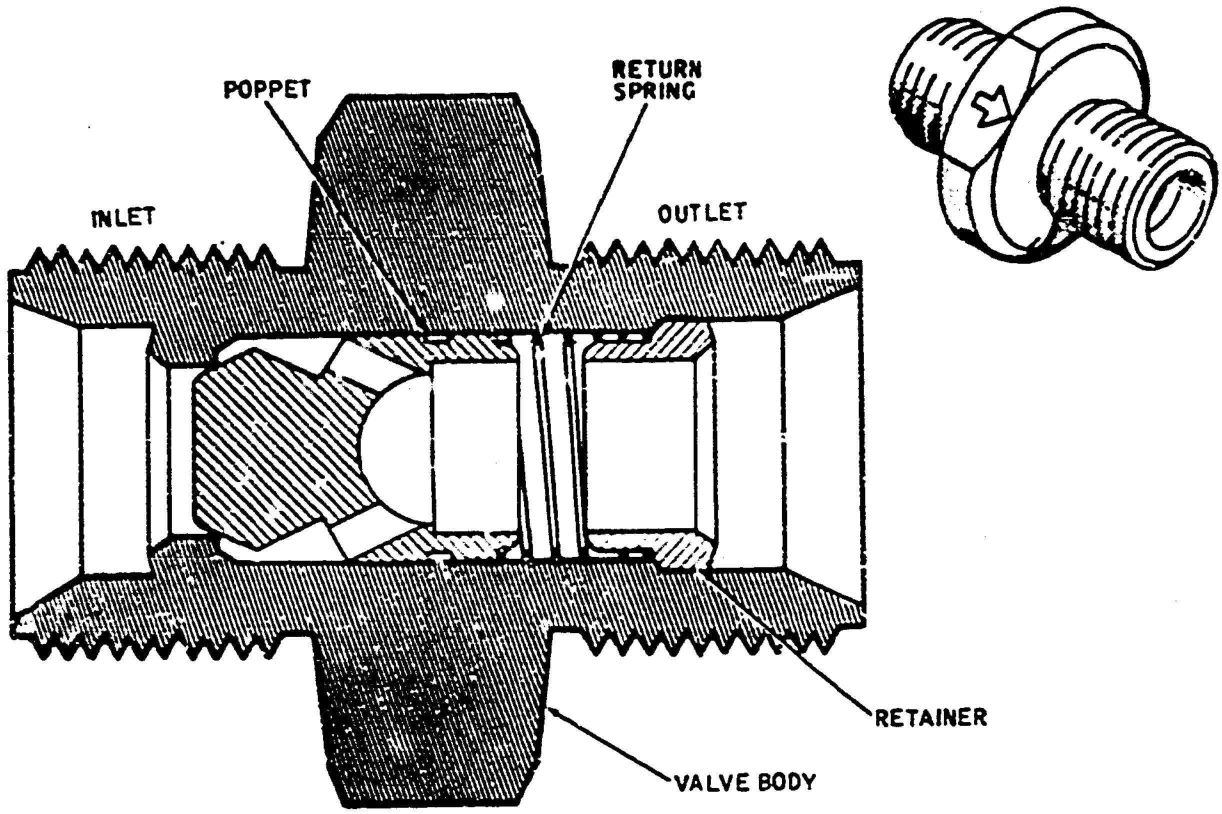
J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

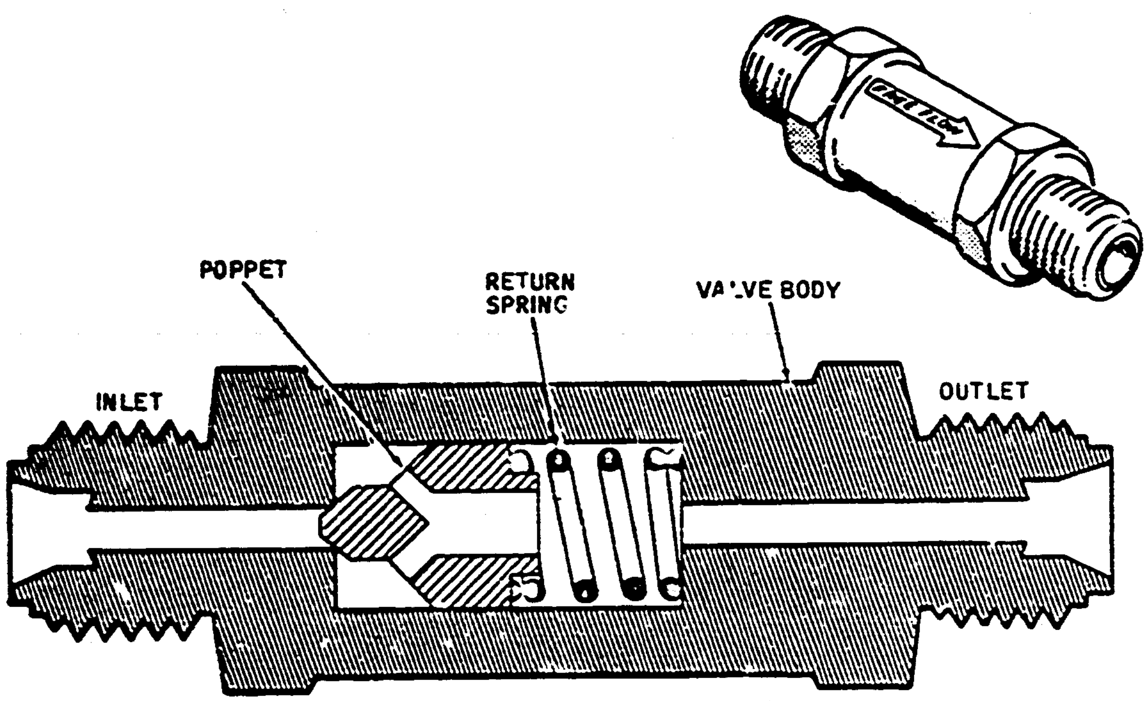
(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.



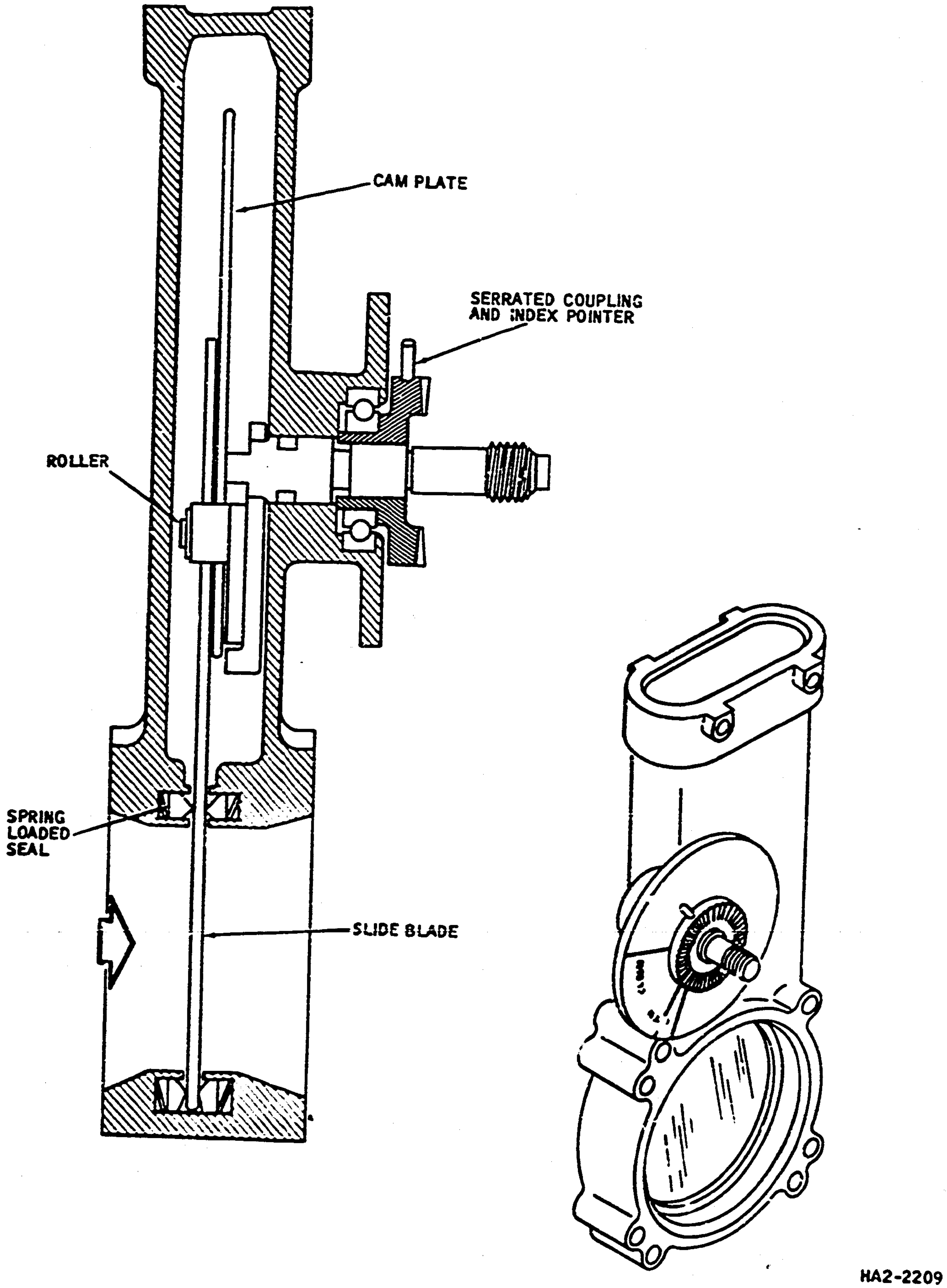
MINIATURE CHECK VALVE



STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11

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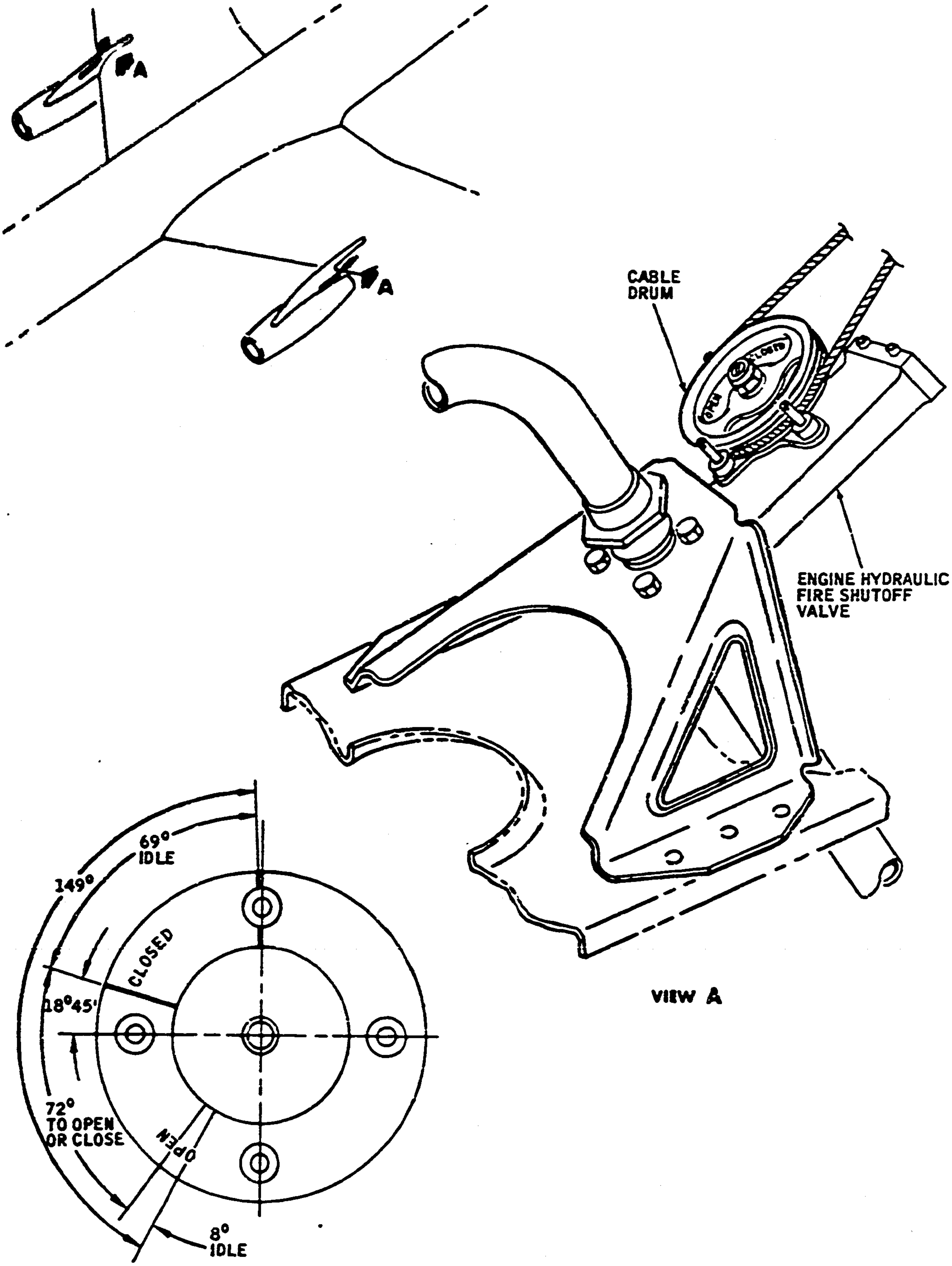


VALVE POSITION DIAGRAM

HA2-2978

Engine Hydraulic Fire Shutoff Valve
Figure 12

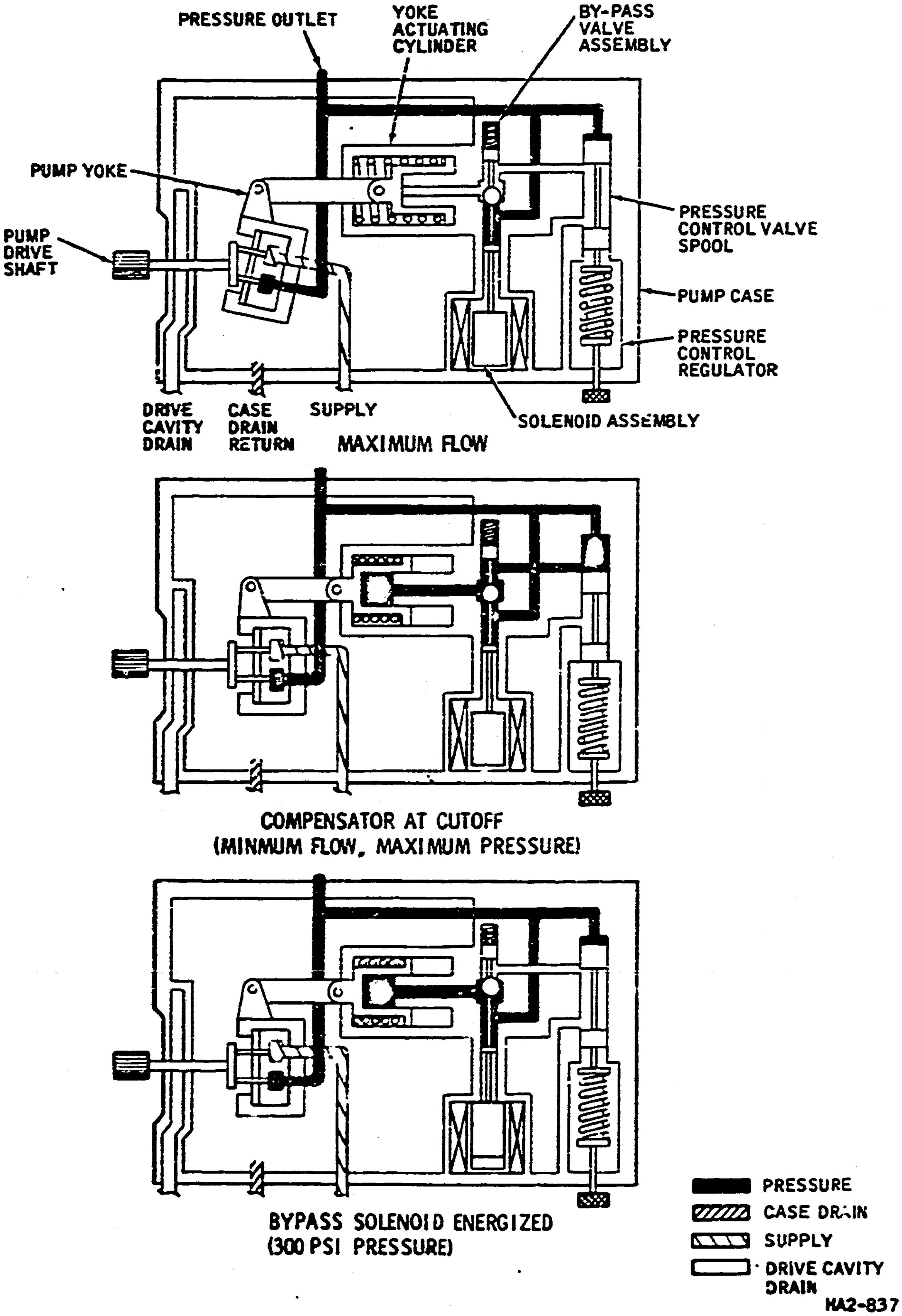
(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handles for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on, and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on, and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles, and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low pressure indicating light switch.



Engine-Driven Hydraulic Pump Pressure Flow -- Schematic
Figure 13

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

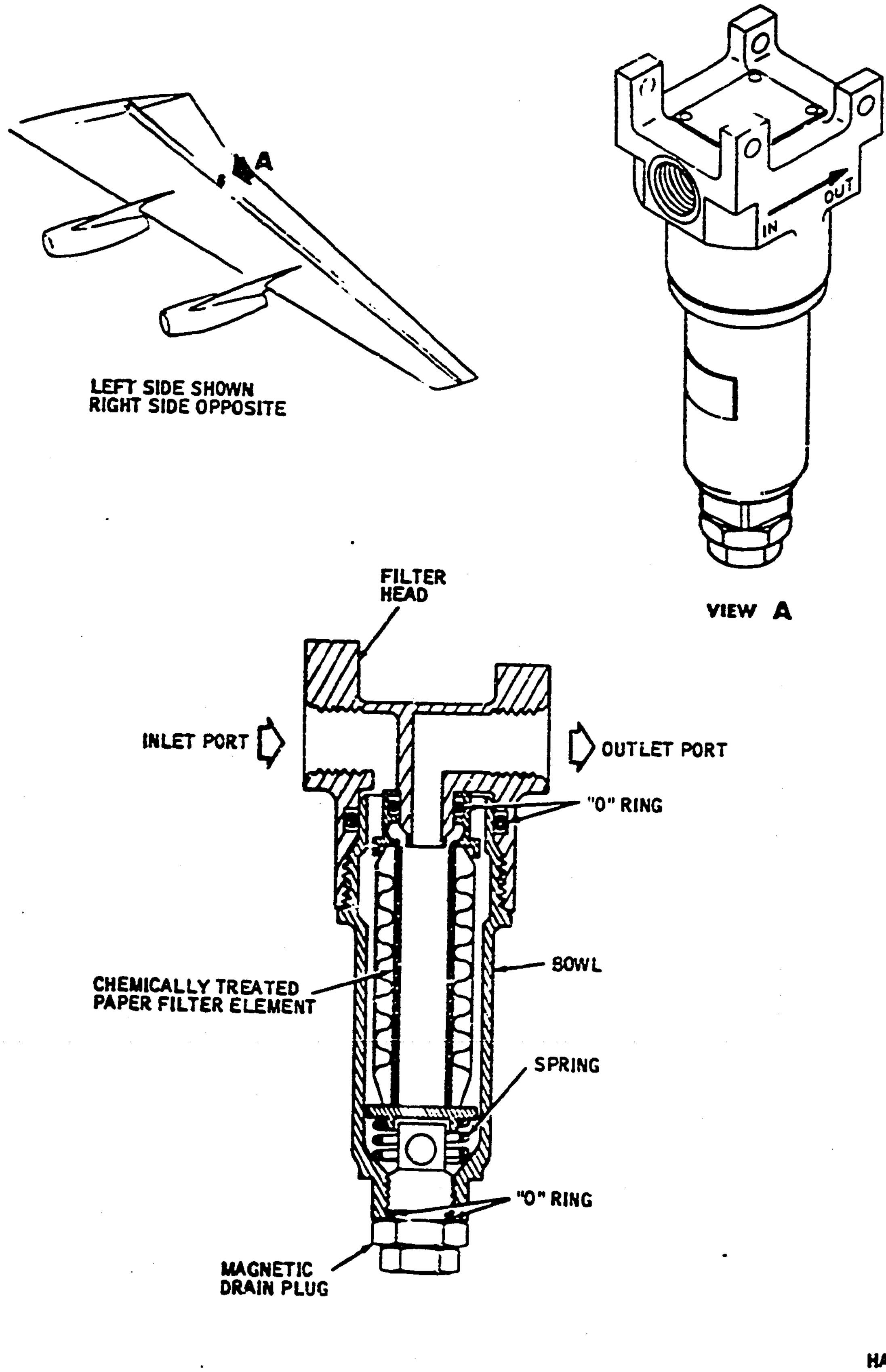
(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

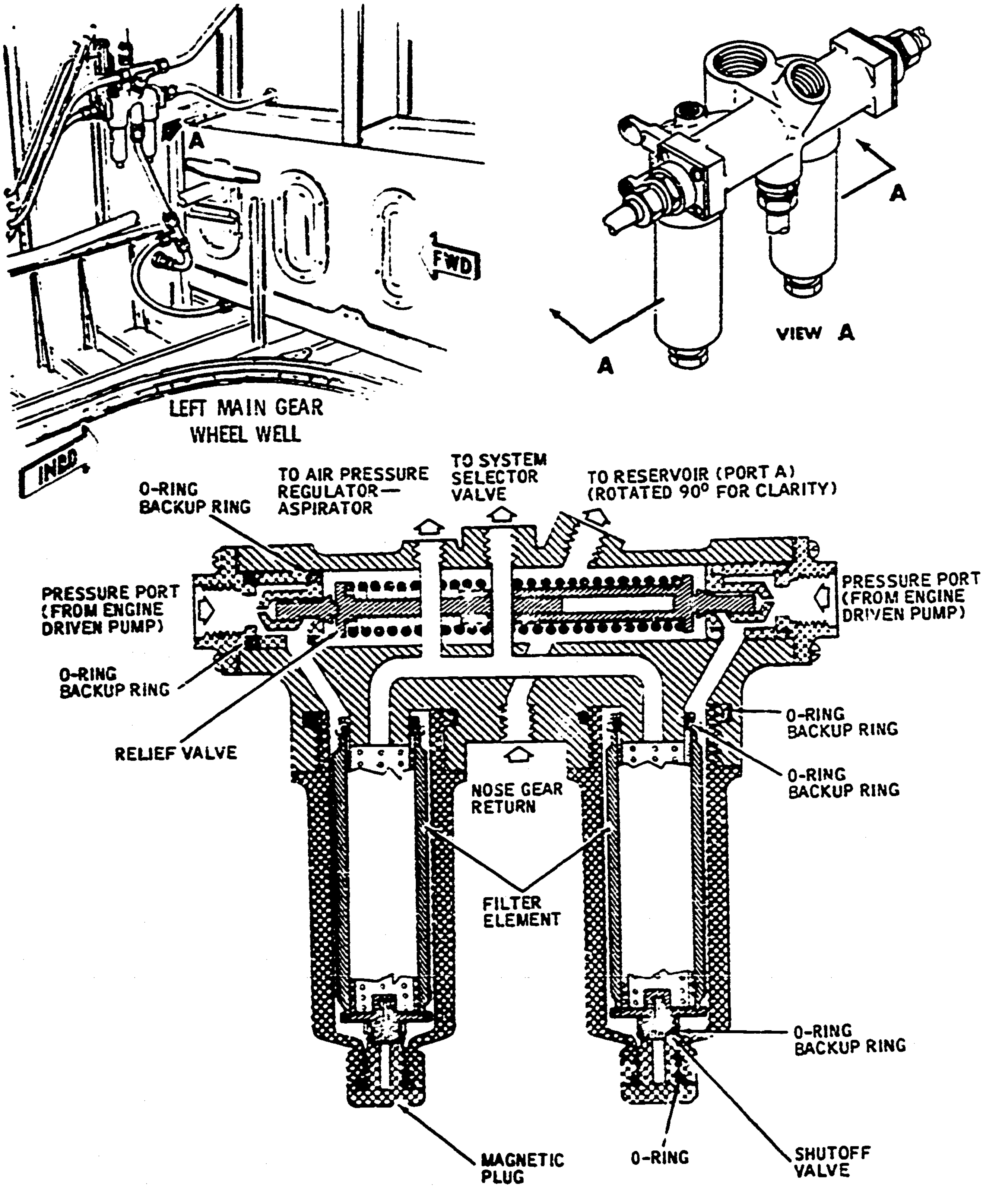
(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.



Engine-Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



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Dual Filter and Relief Valve -- Cutaway View
Figure 15

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

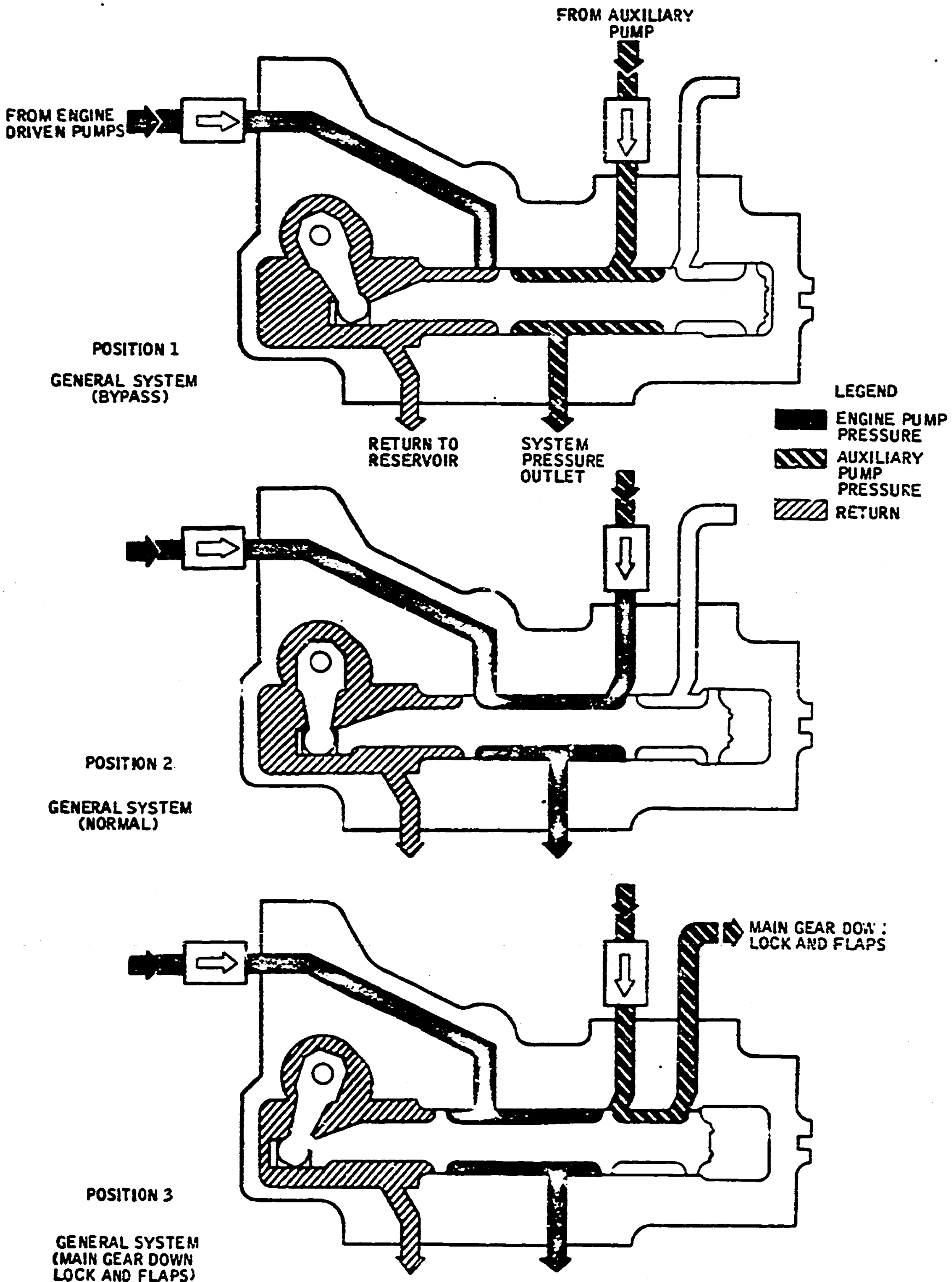
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

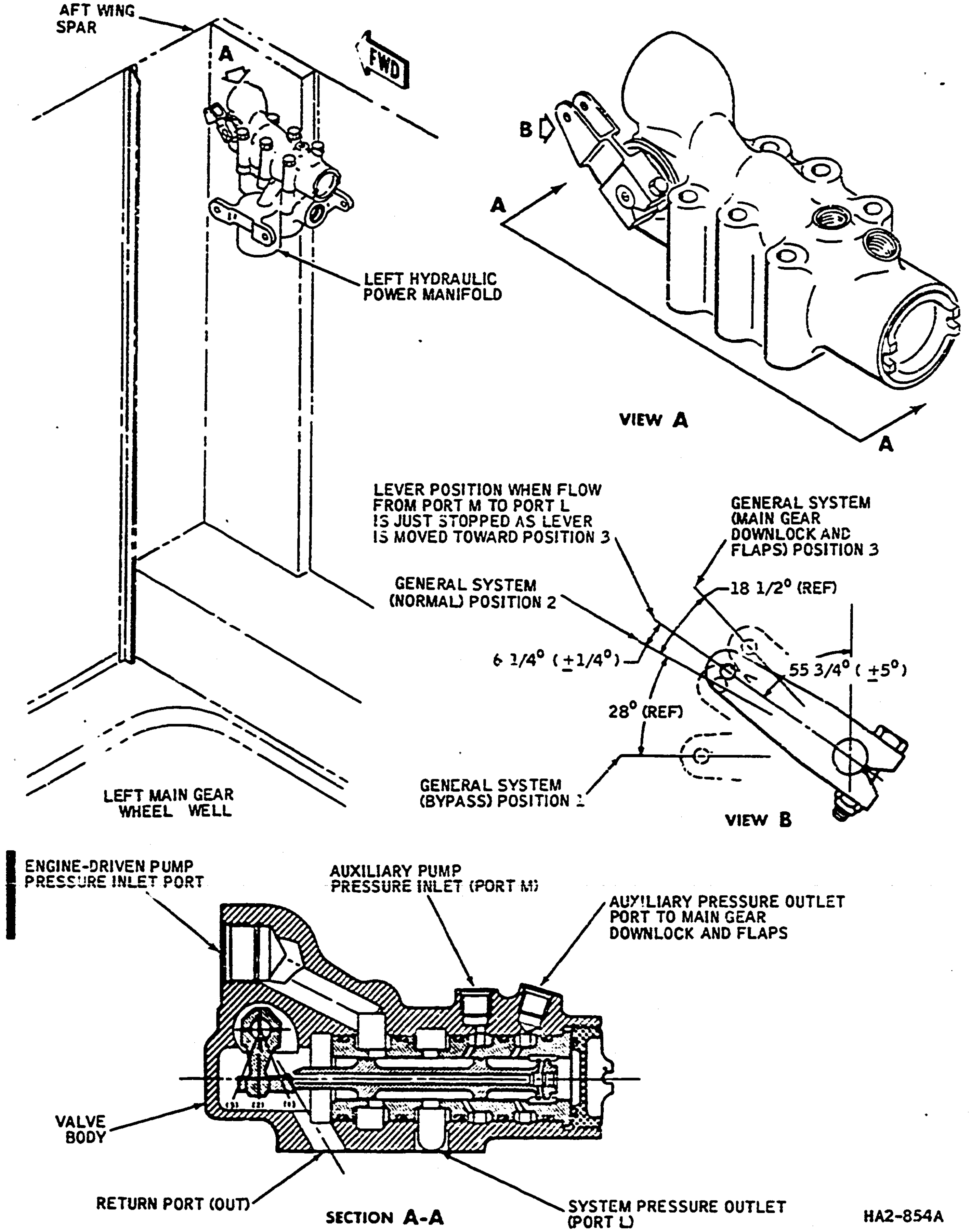
P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic sybsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

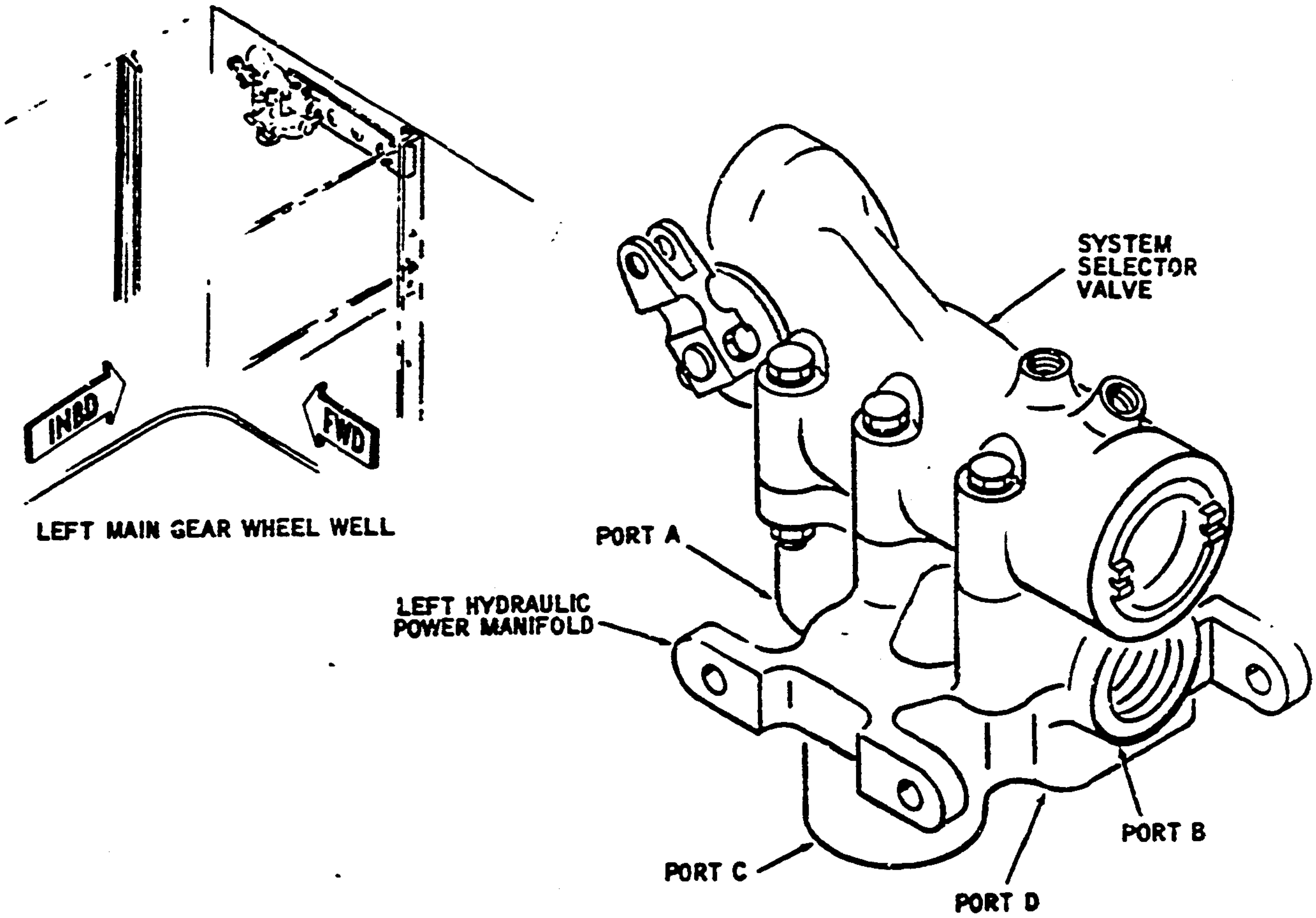
(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nosegear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

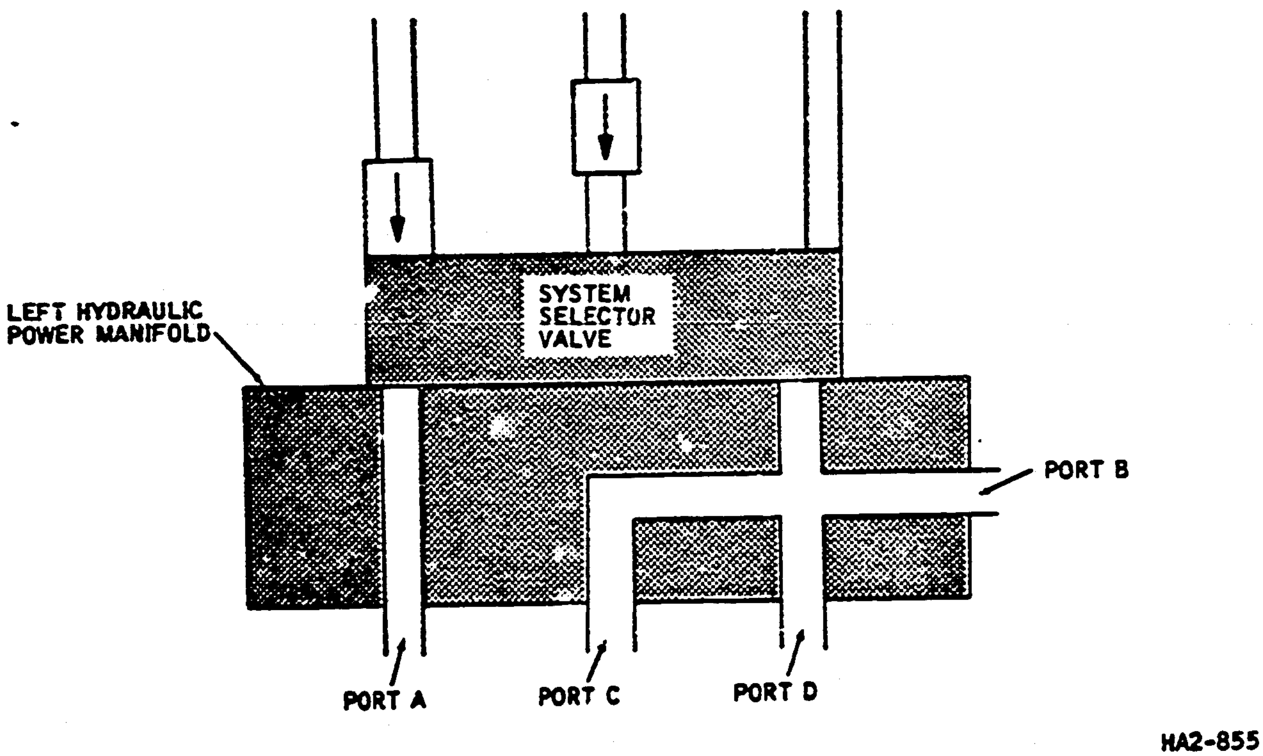


System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17





Left Hydraulic Power Manifold -- Schematic
Figure 18

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

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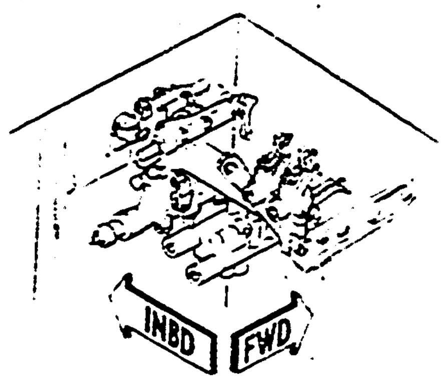
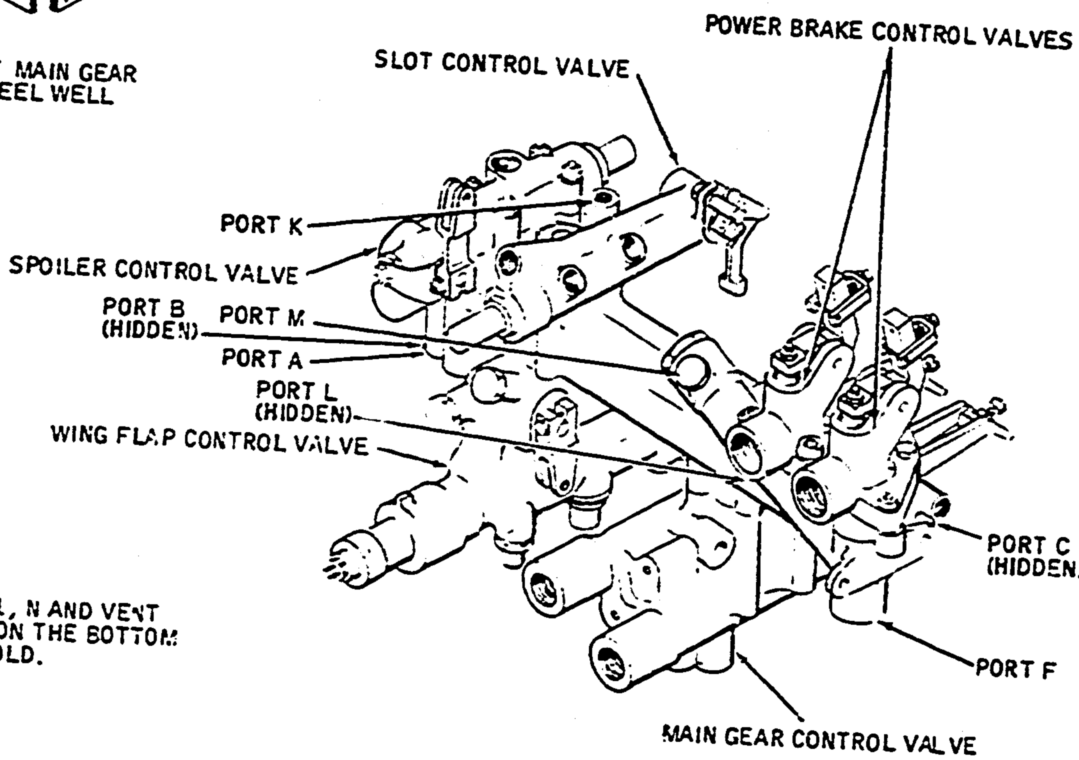
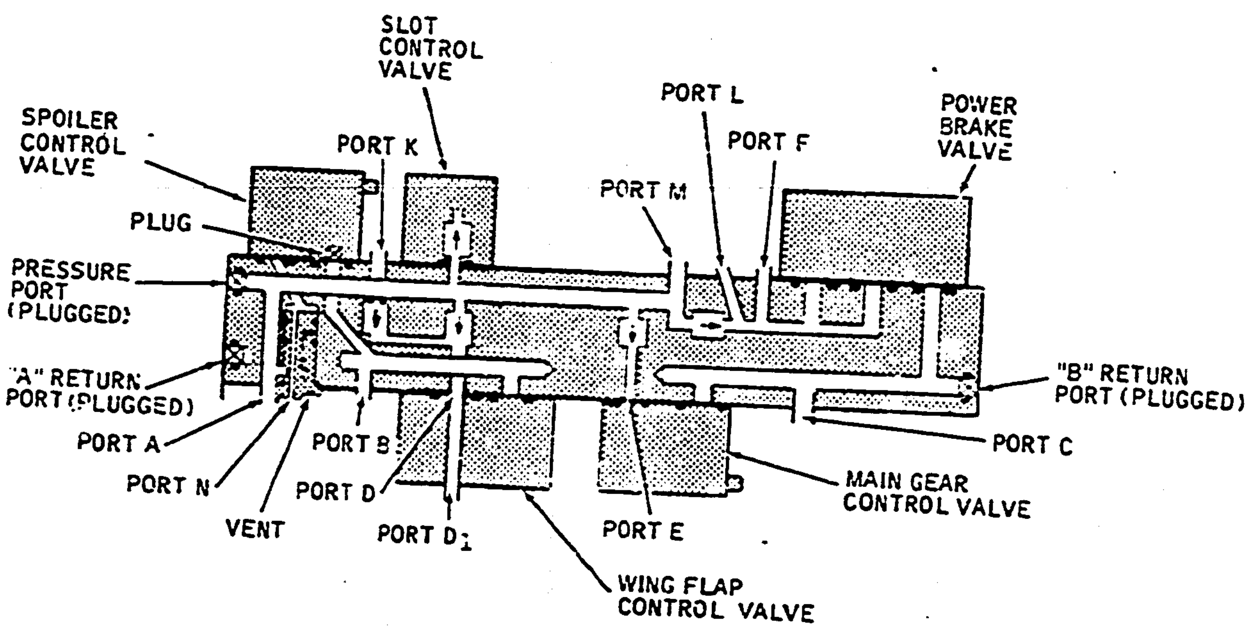




NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

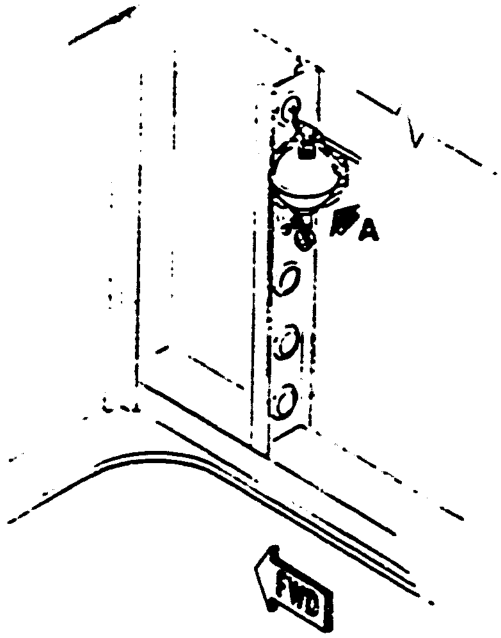
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

T. Hydraulic System Priority Valve (See Figure 21.)

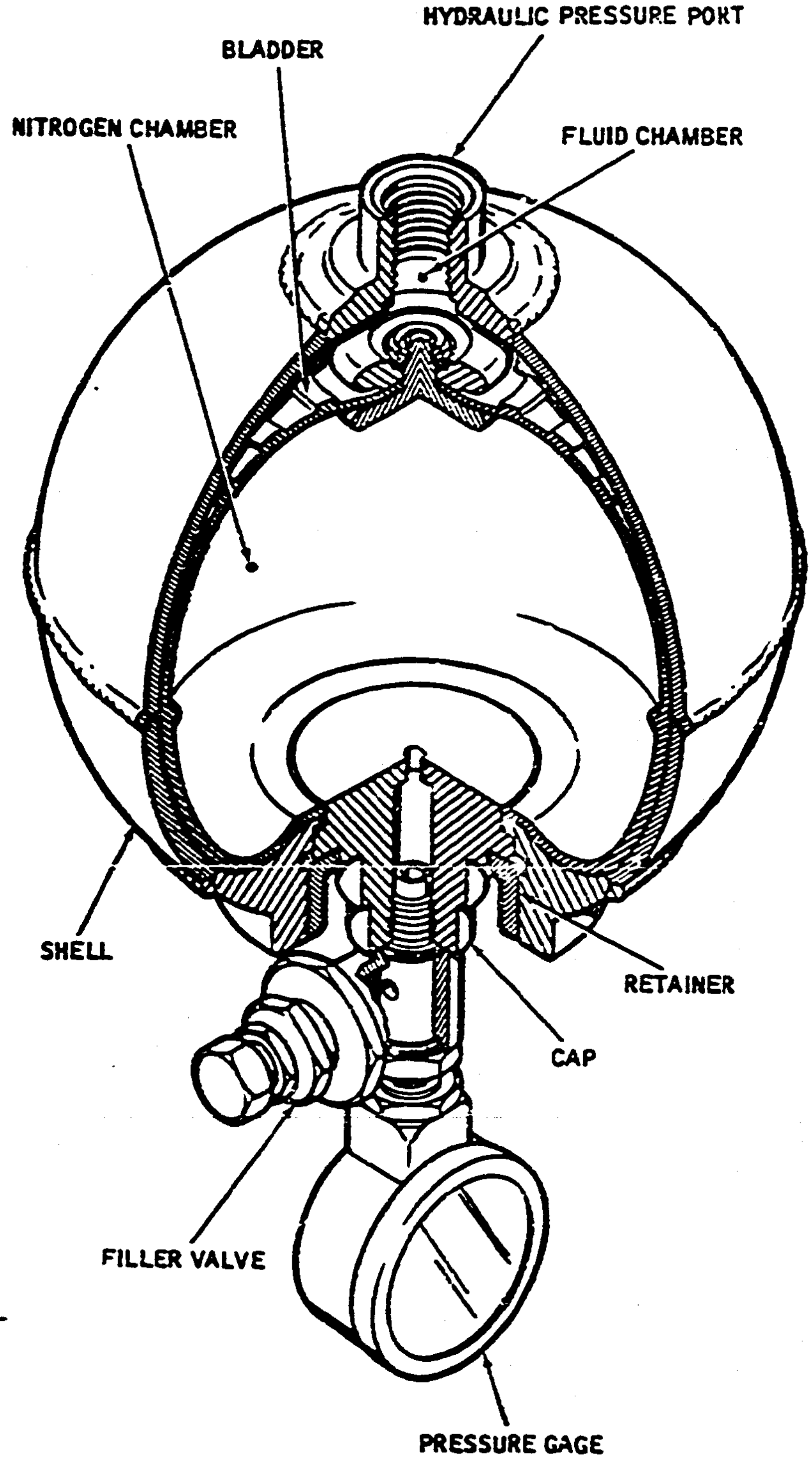
(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing, The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

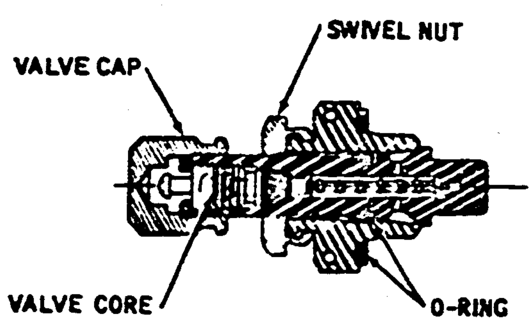
(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and



LEFT MAIN GEAR
WHEEL WELL



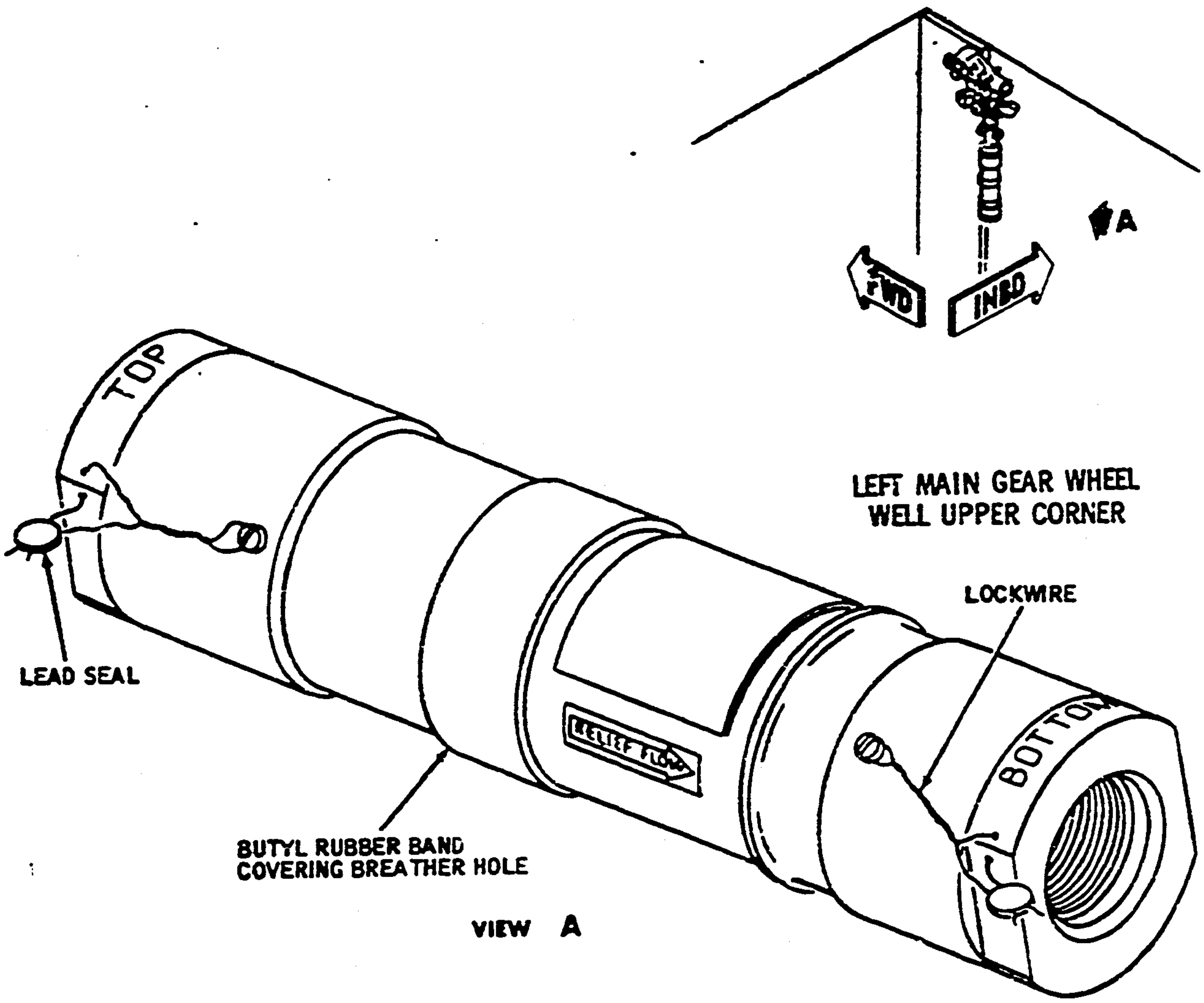


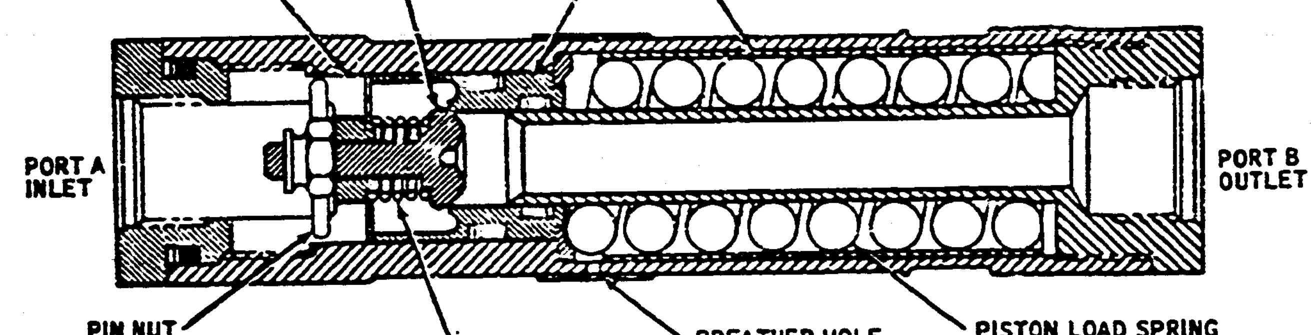
FILLER VALVE

VIEW A

HA2-30

Hydraulic Power System Accumulator -- Cutaway View
Figure 20





Hydraulic System Priority Valve -- Cutaway View
Figure 21

applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move

the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the system selector valve sector to the No. 2 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

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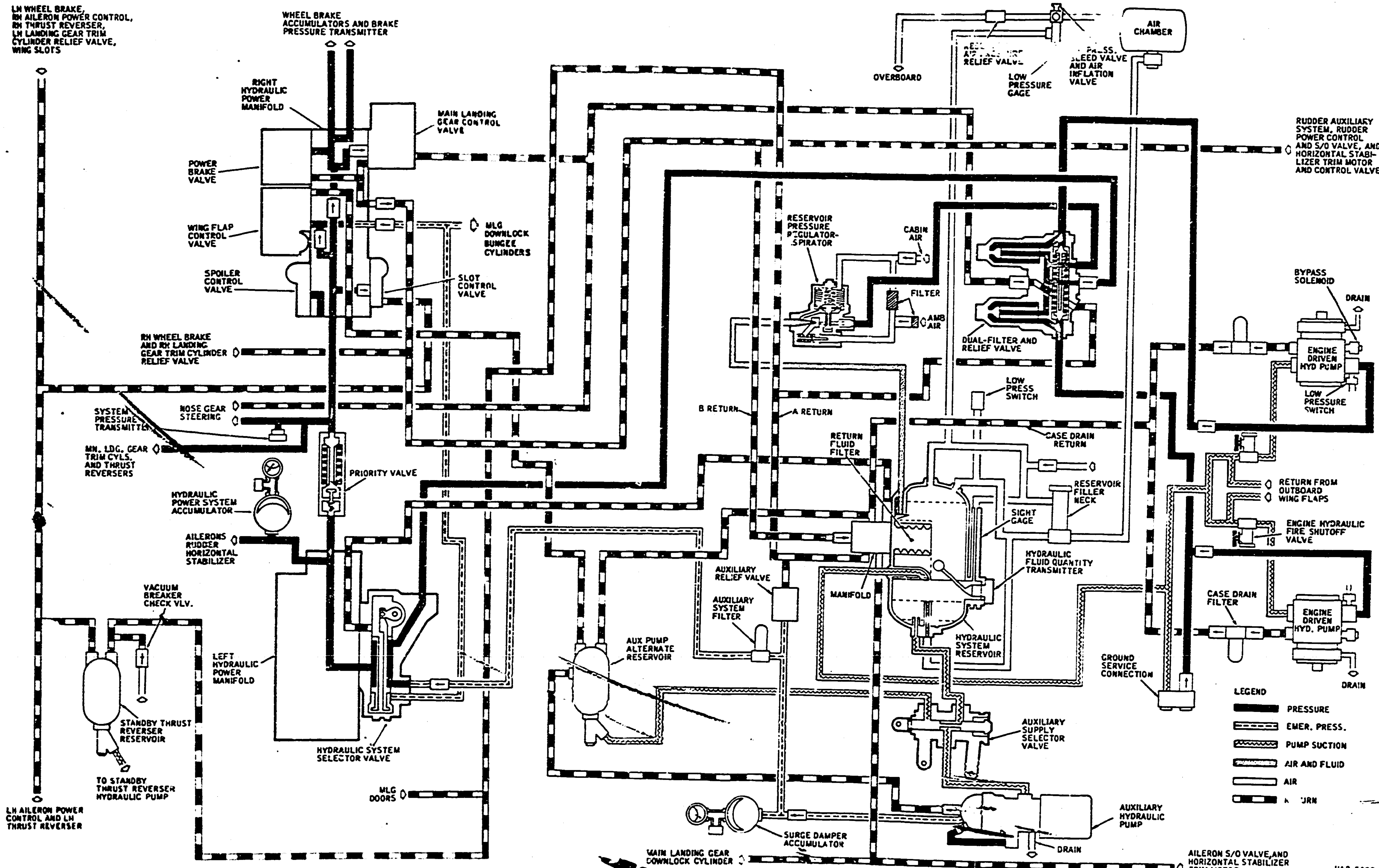
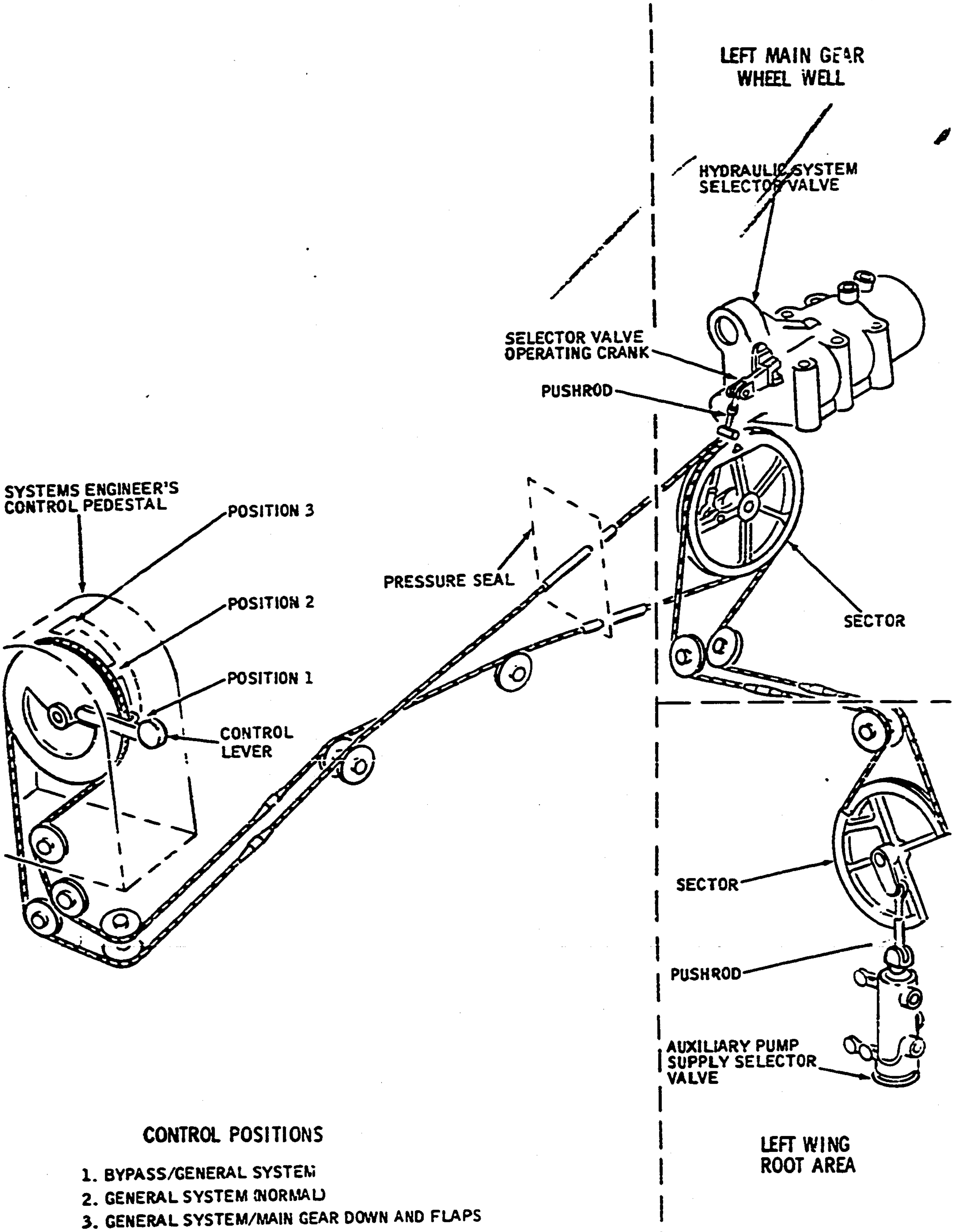


Hydraulic Power System -- Schematic Diagram
Figure 1



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at normal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring-loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the

auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

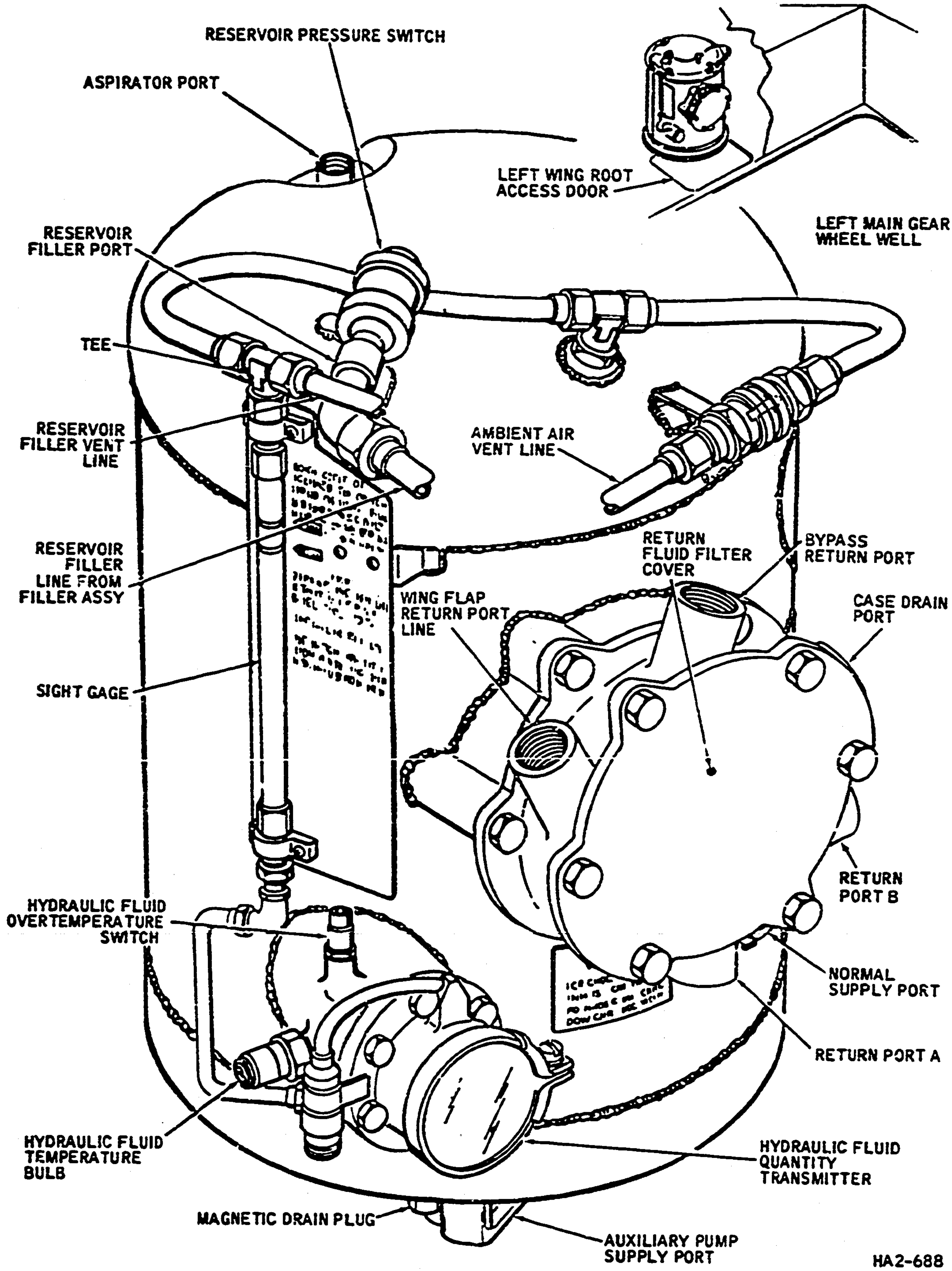
(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to between 30 and 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

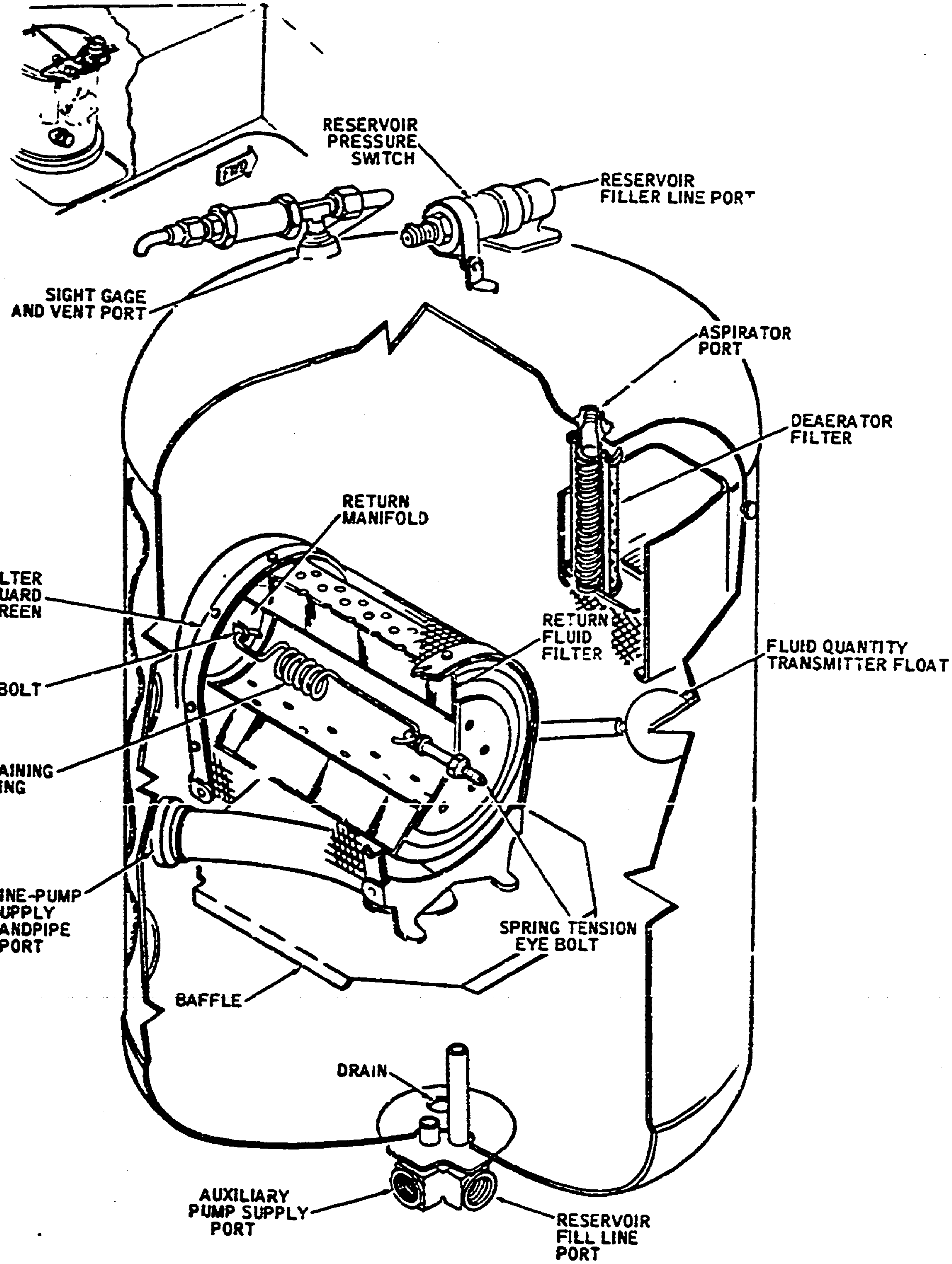
(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

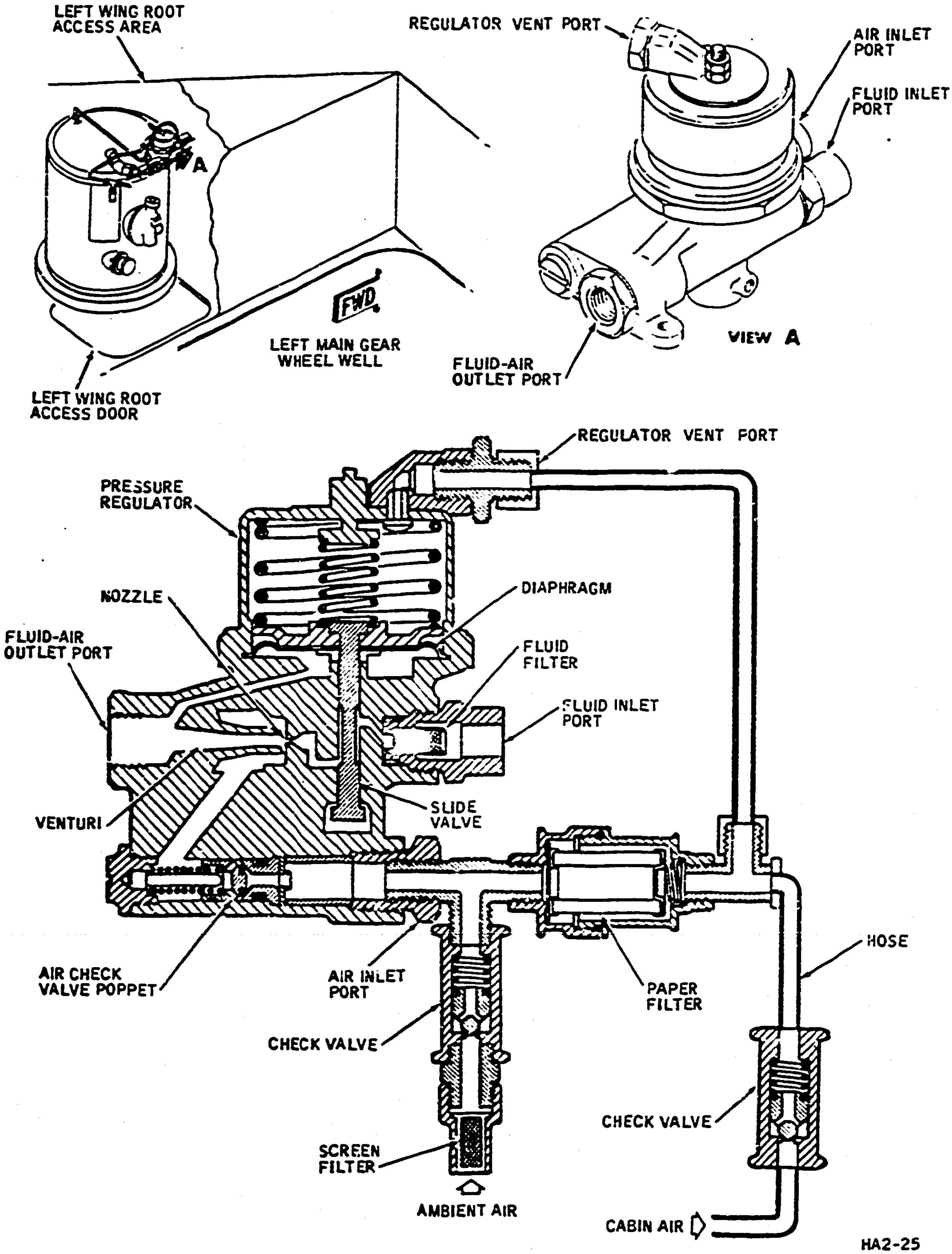
(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes Foreign matter is filtered out by the filter element. and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

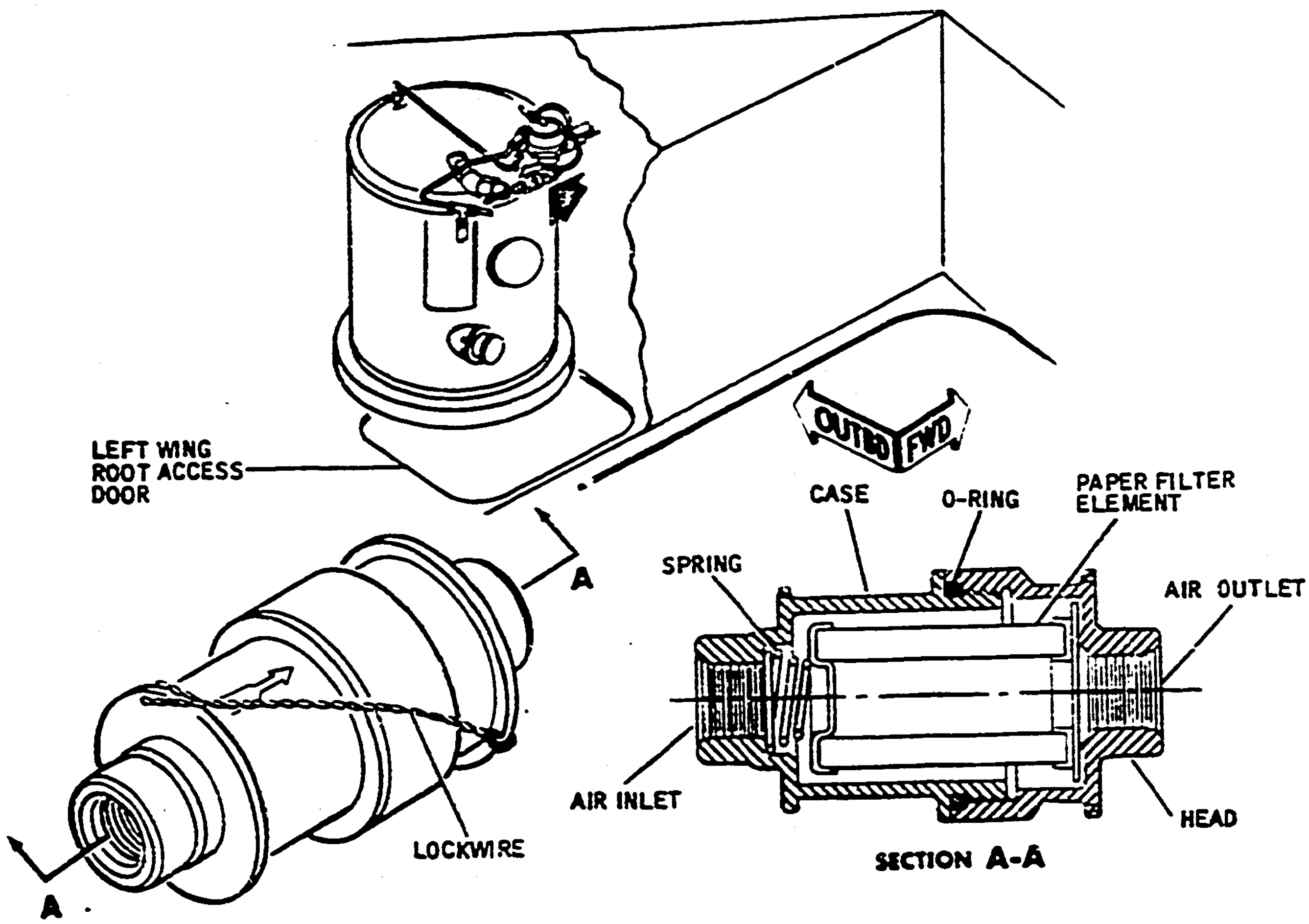
(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

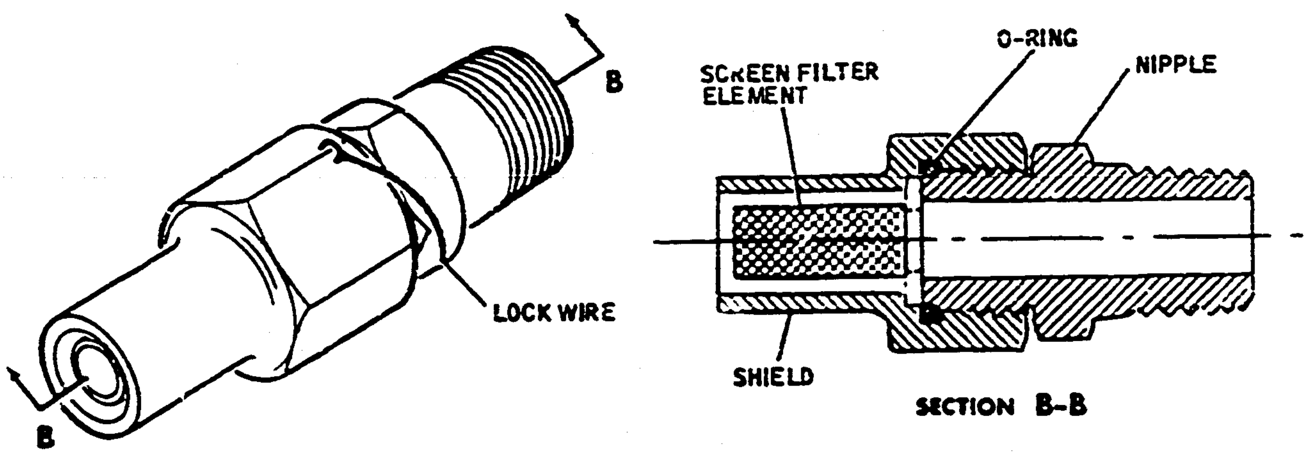
(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.



PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters - Cutaway View
Figure 6

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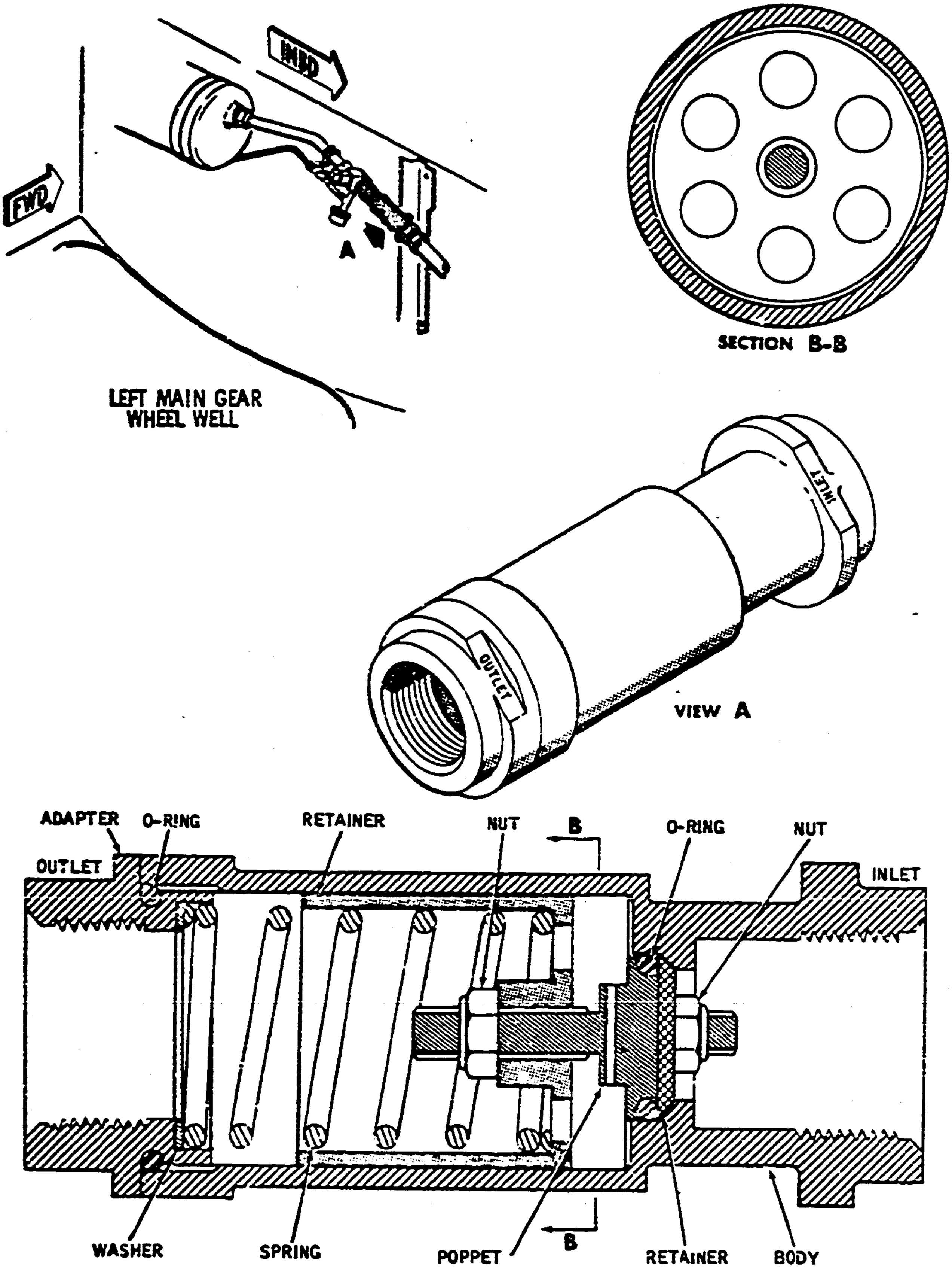

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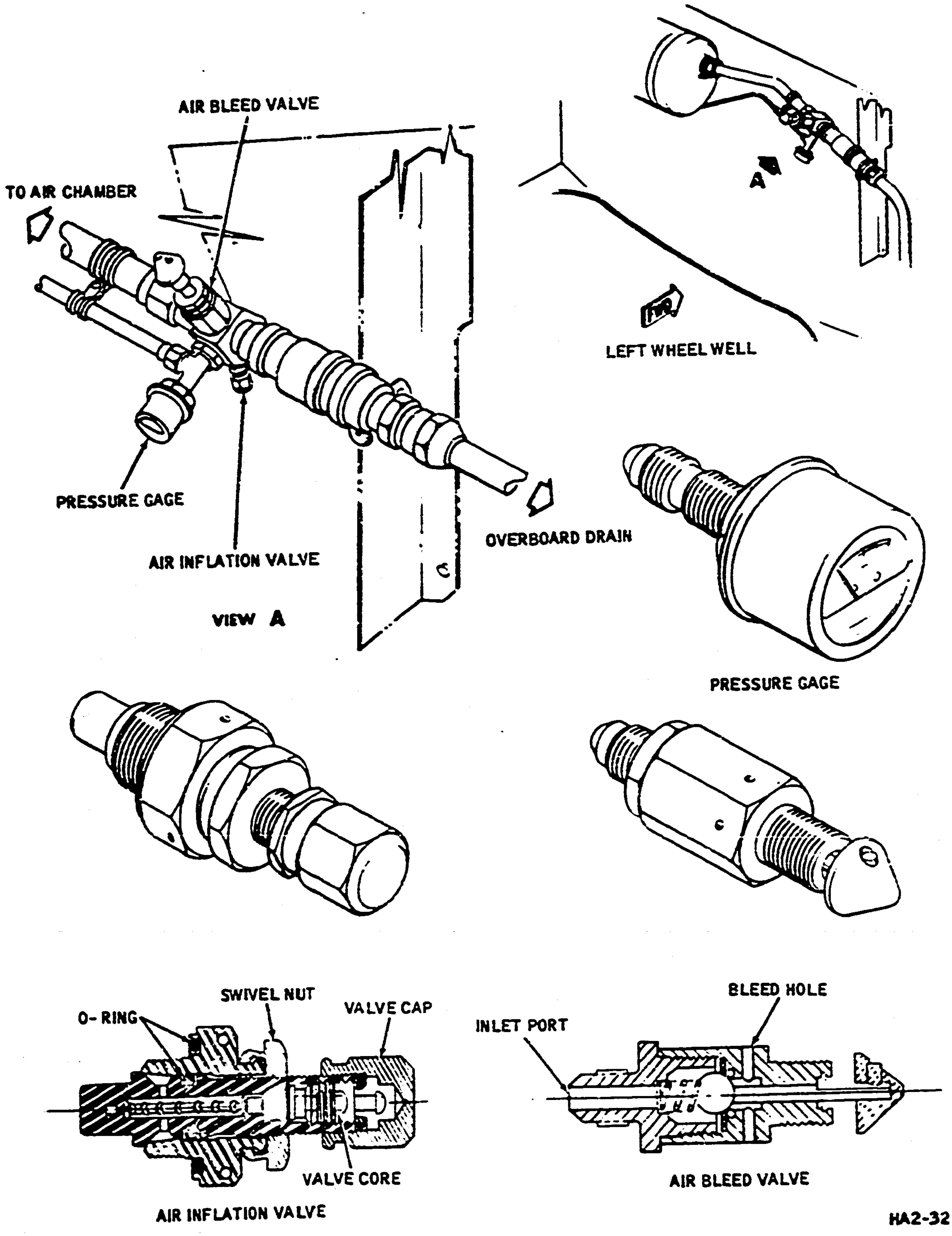
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air b[illegible] valve located downstream of the chamber. The air chamber is mount[illegible] higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

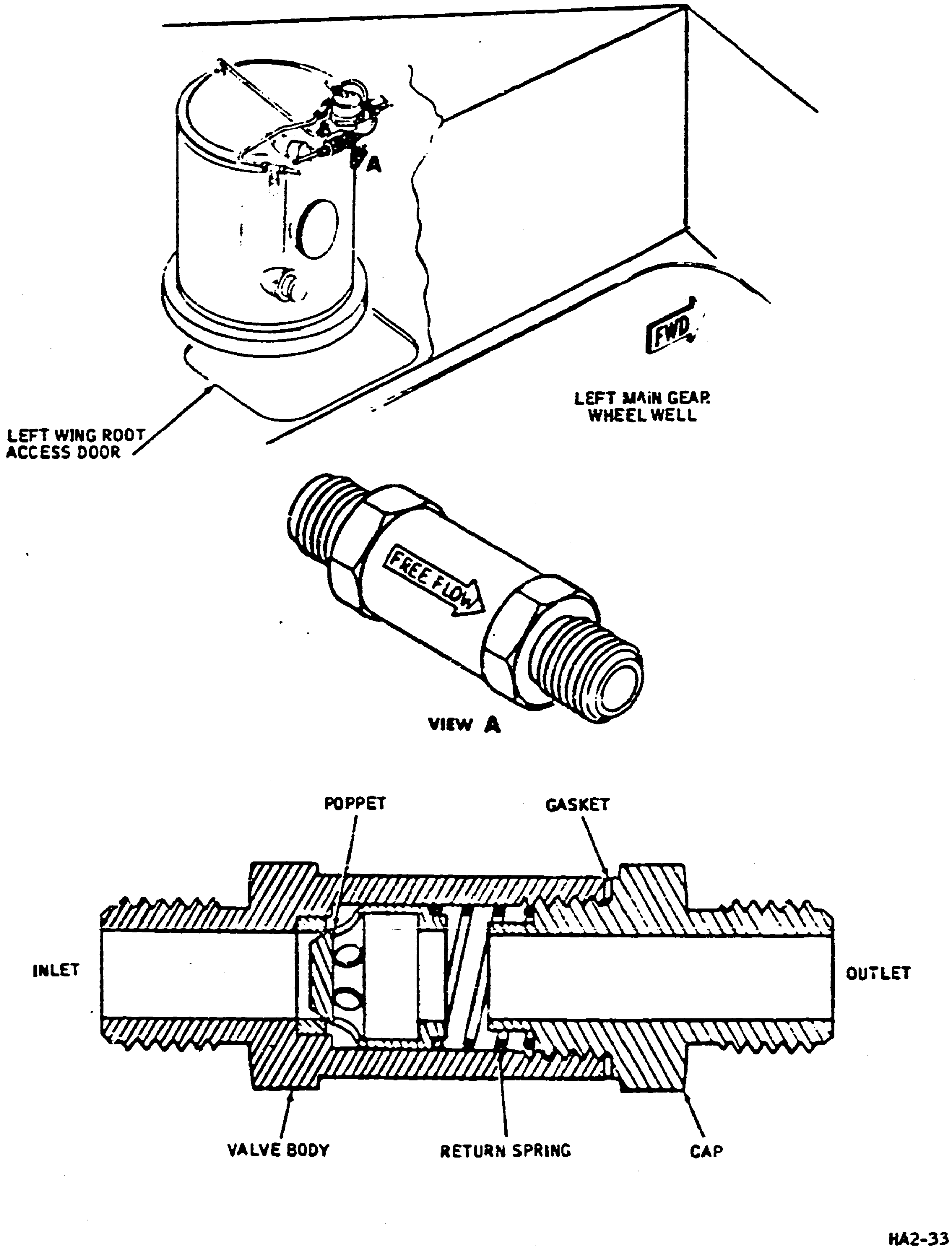
I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

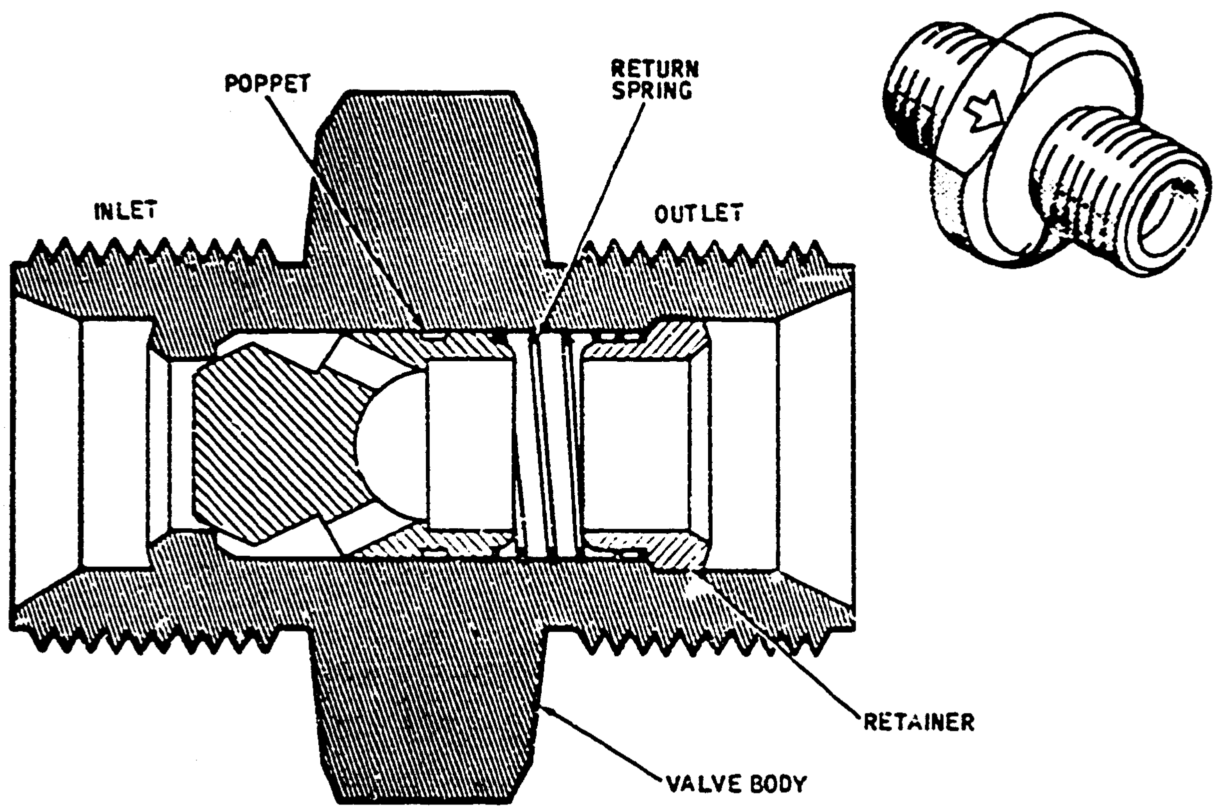
(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

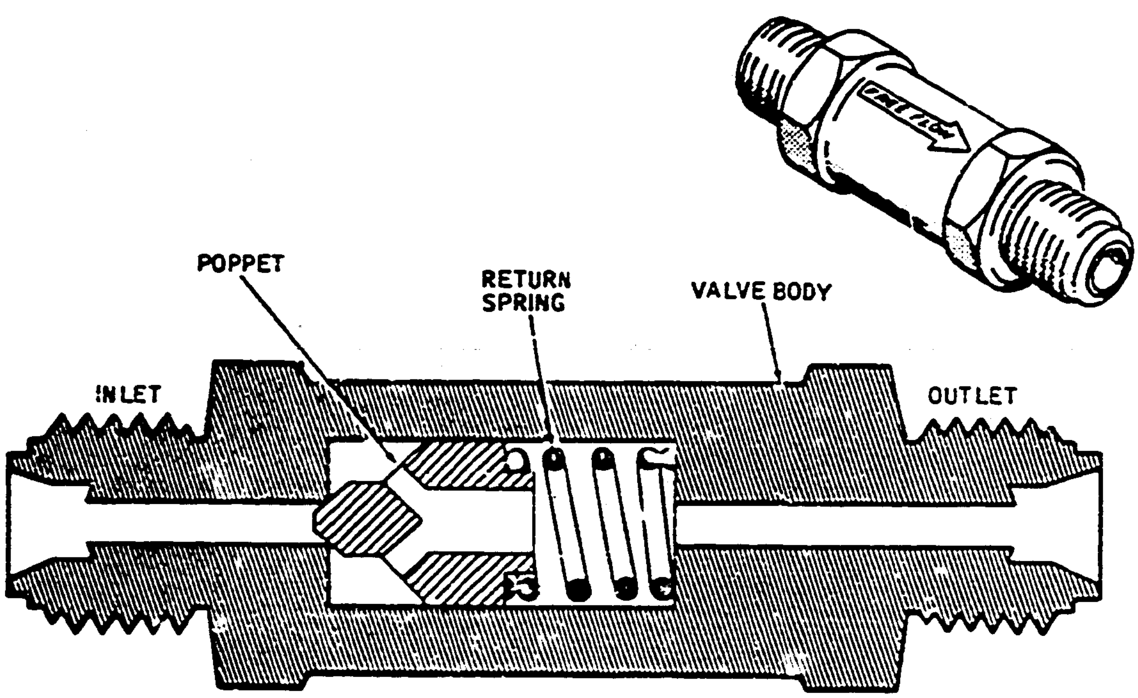
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated



Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9



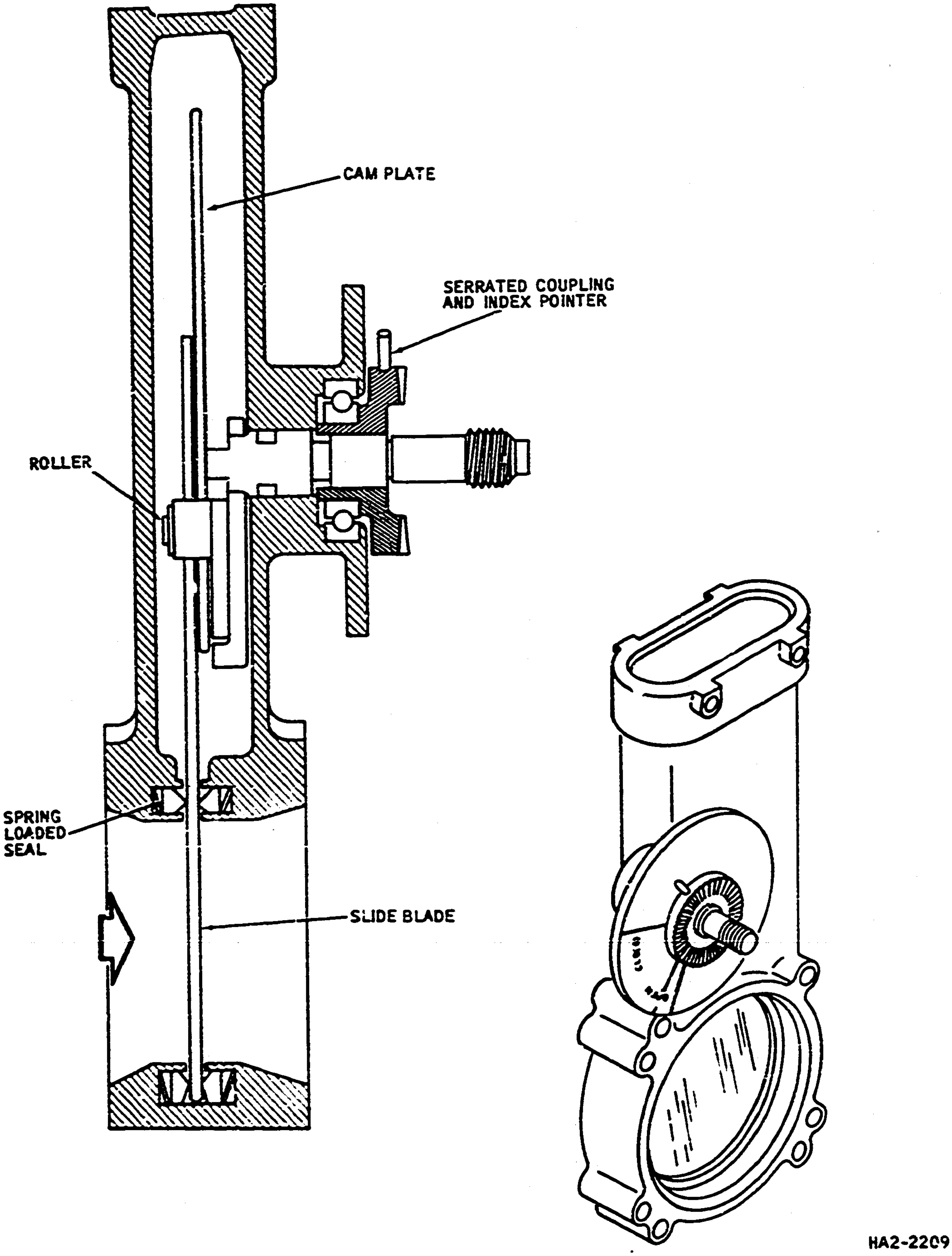
MINIATURE CHECK VALVE



STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11

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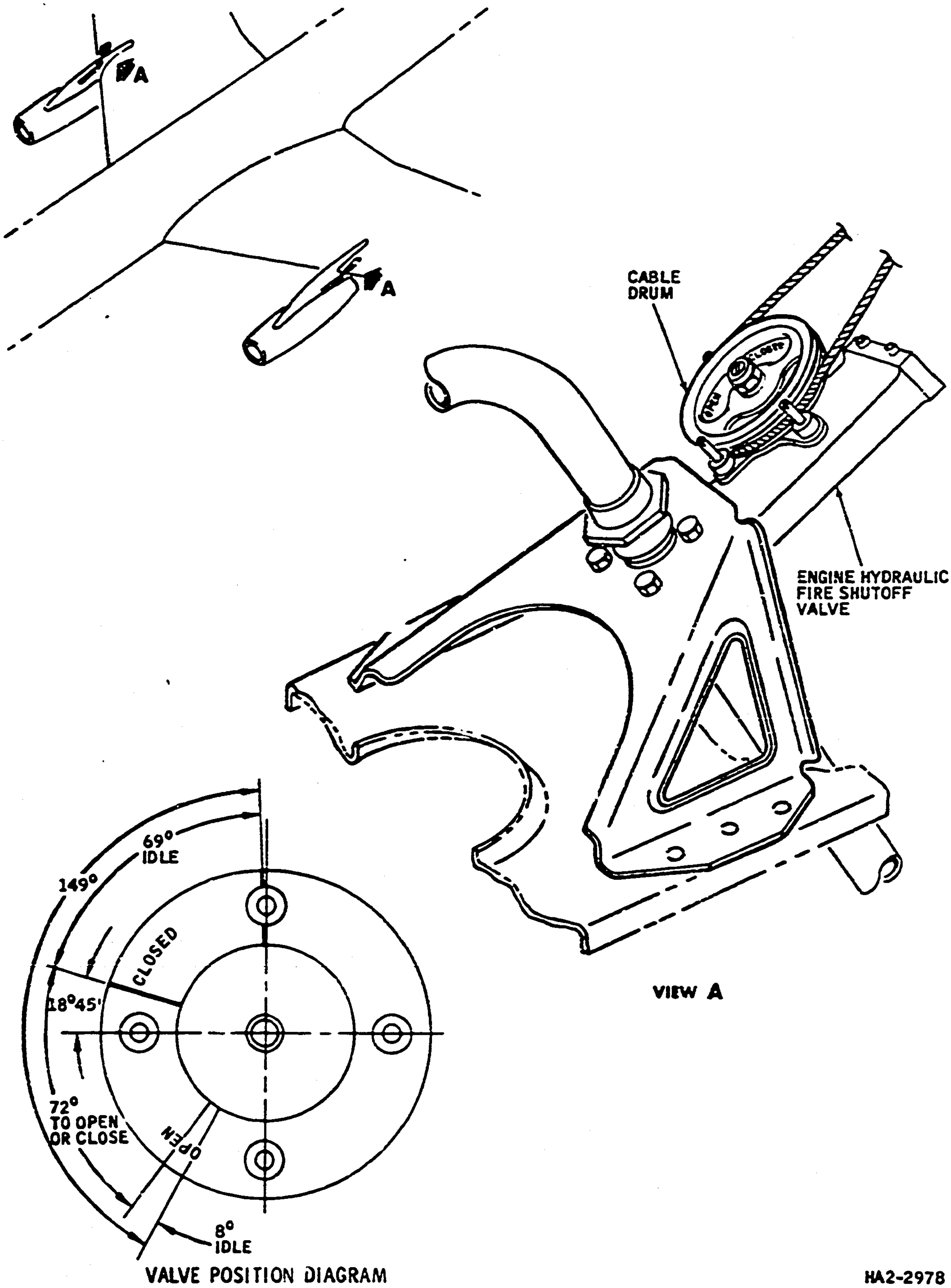


Engine Hydraulic Fire Shutoff Valve
Figure 12

from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

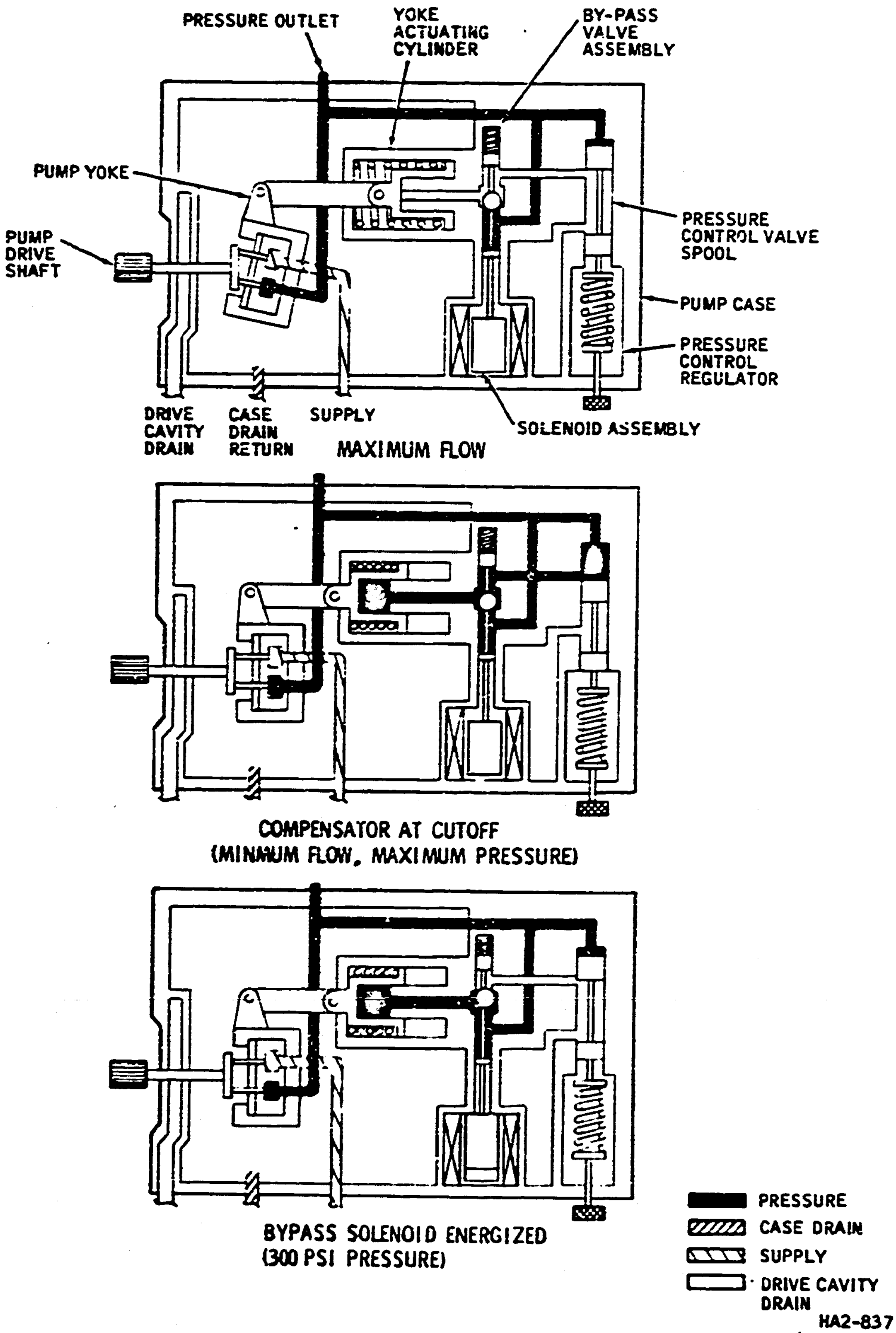
(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handles for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump switches in the



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to approximately 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the doors on the right side of the nacelles, and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port at the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low-pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid assembly, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. If the engine-driven hydraulic pump control switches are in the on position, and the output pressure of either pump drops below 1500 psi, an amber light located in the flight compartment comes on.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

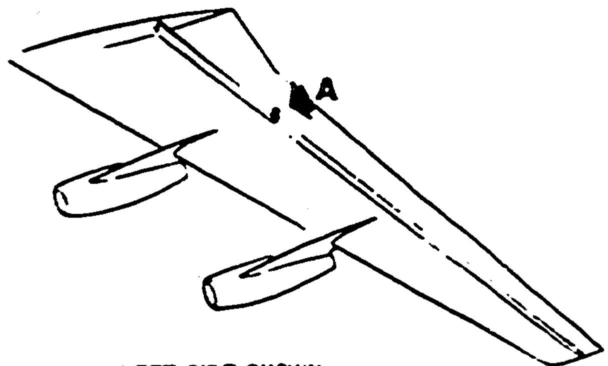
M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

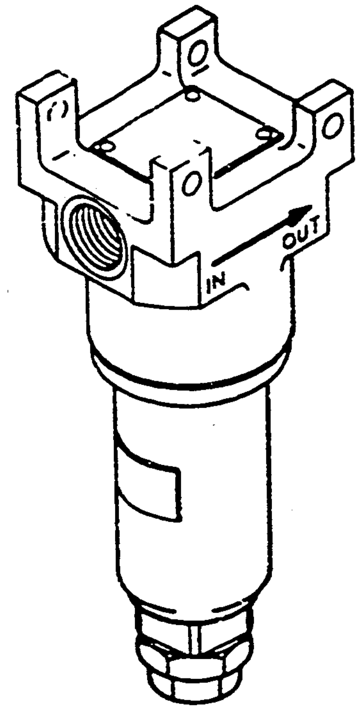
(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

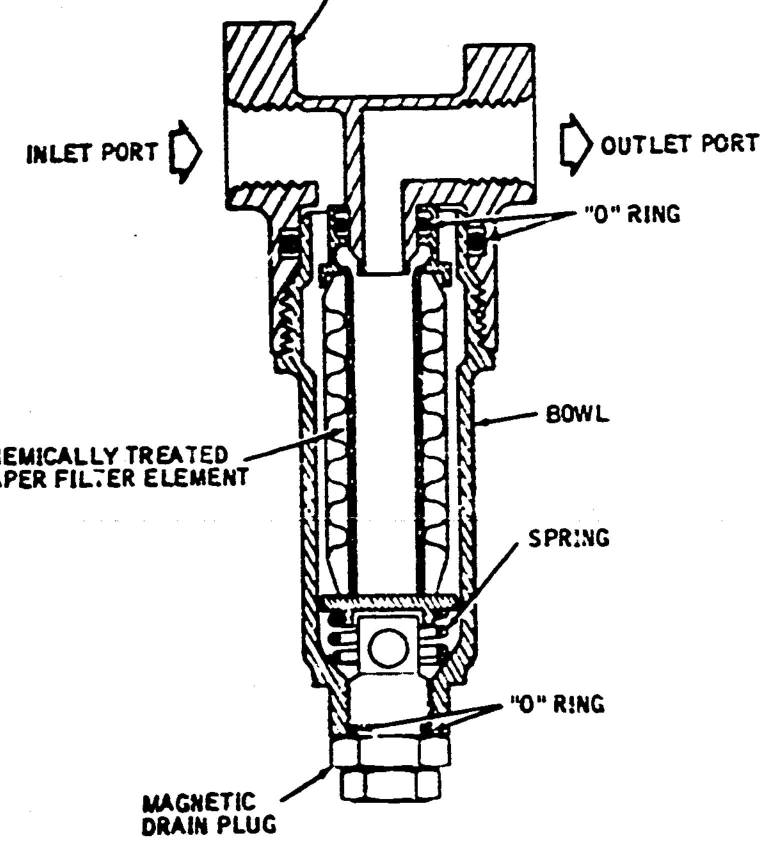
N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.





VIEW A



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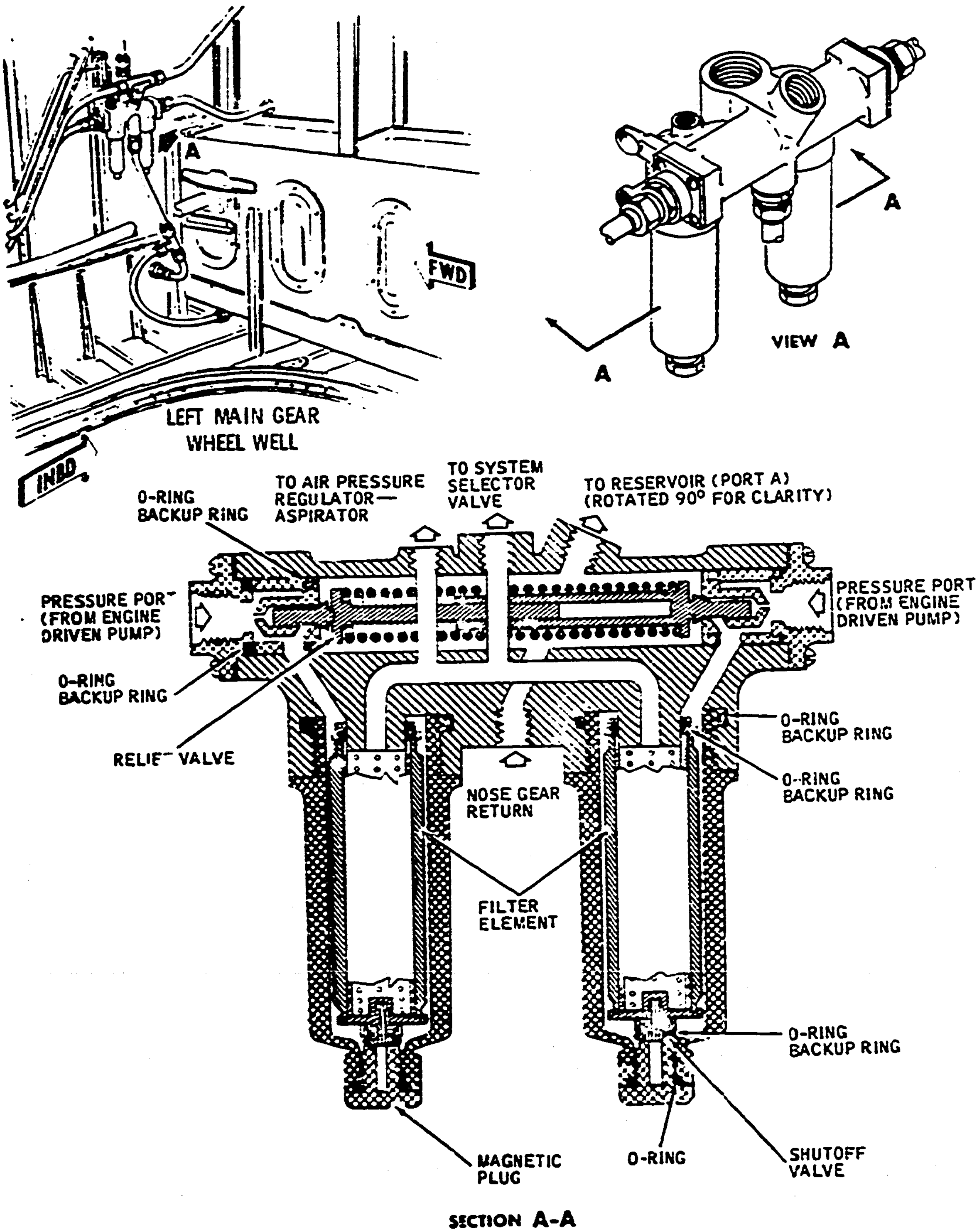
Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



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Dual Filter and Relief Valve -- Cutaway View
Figure 15

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

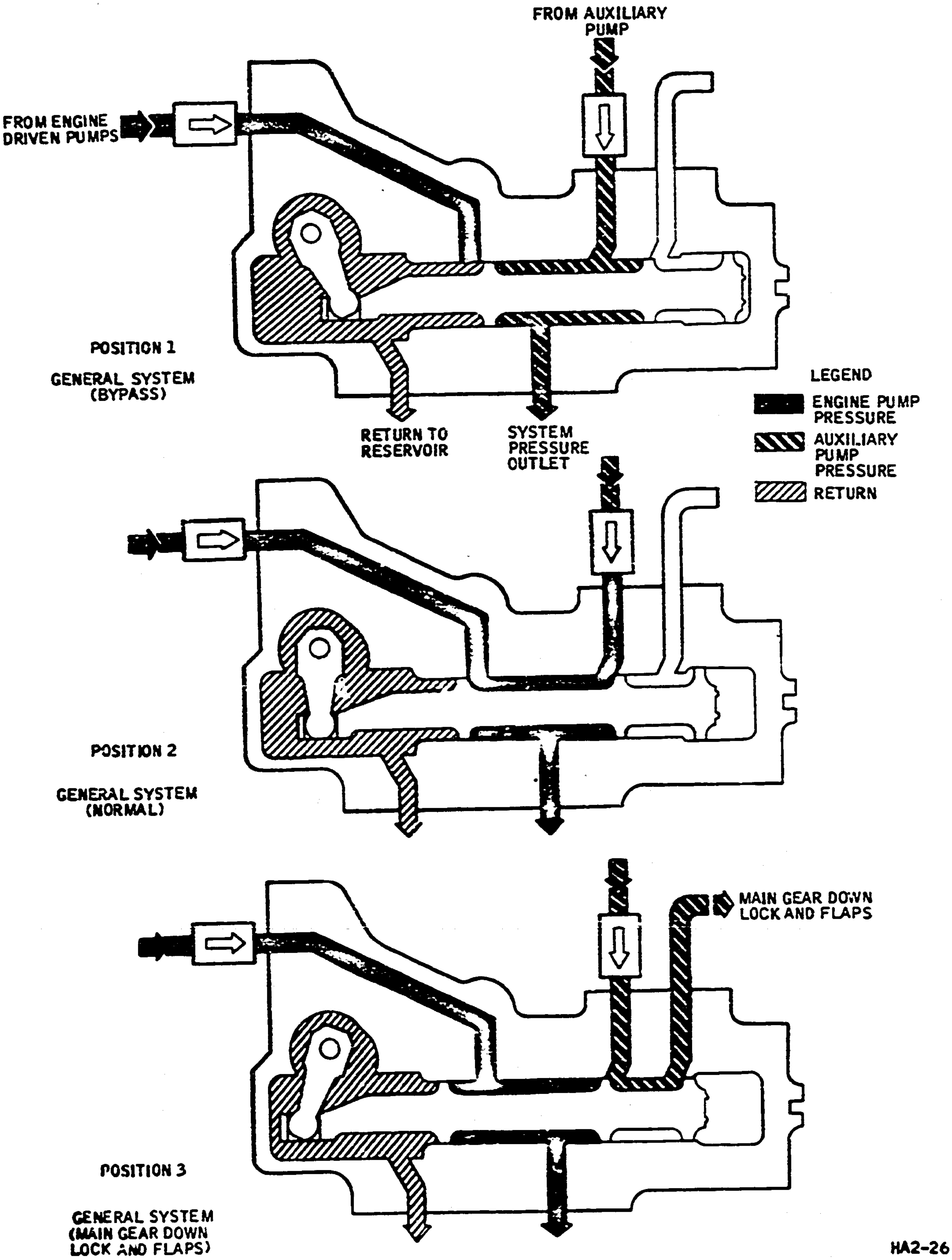
(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

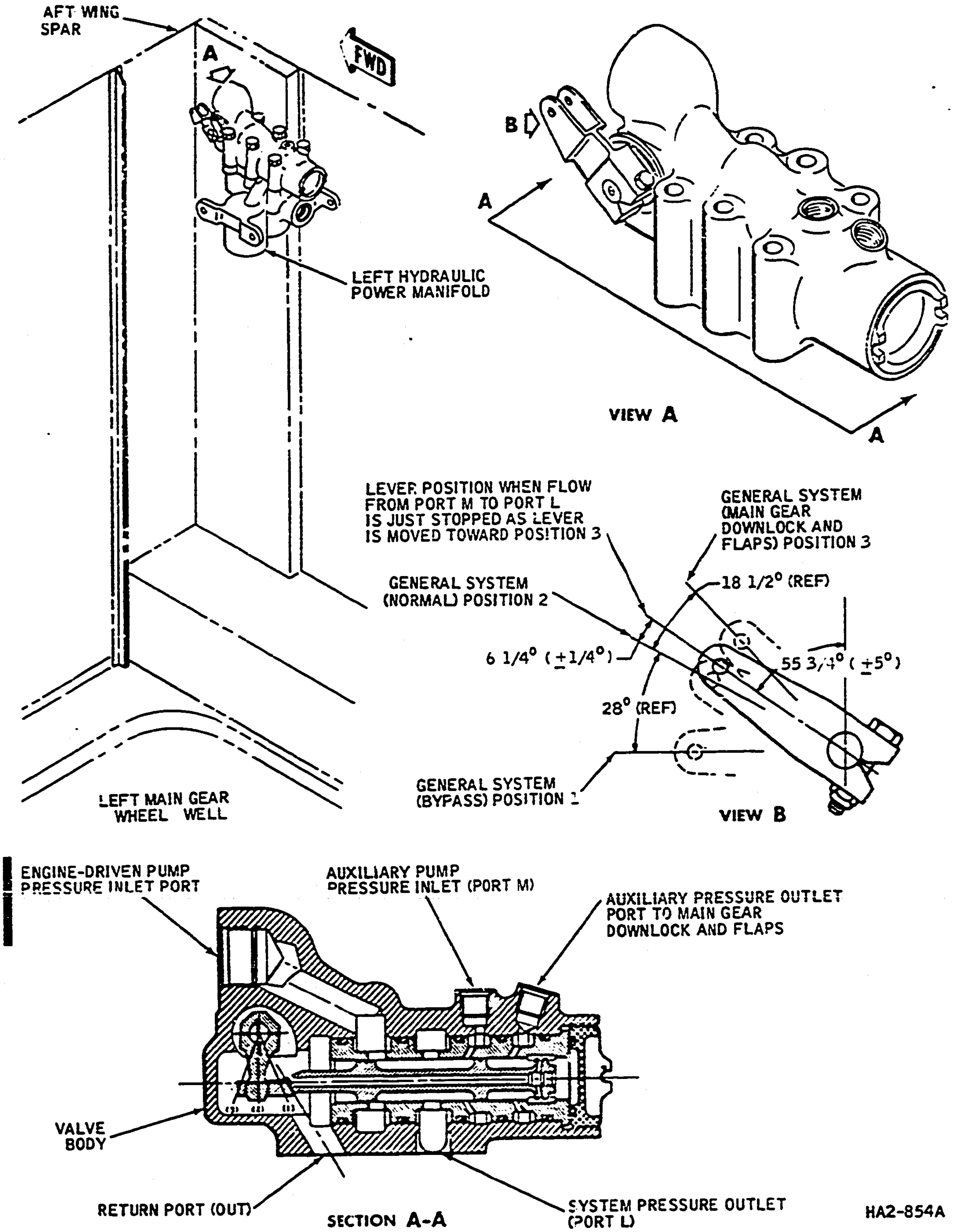
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17

to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

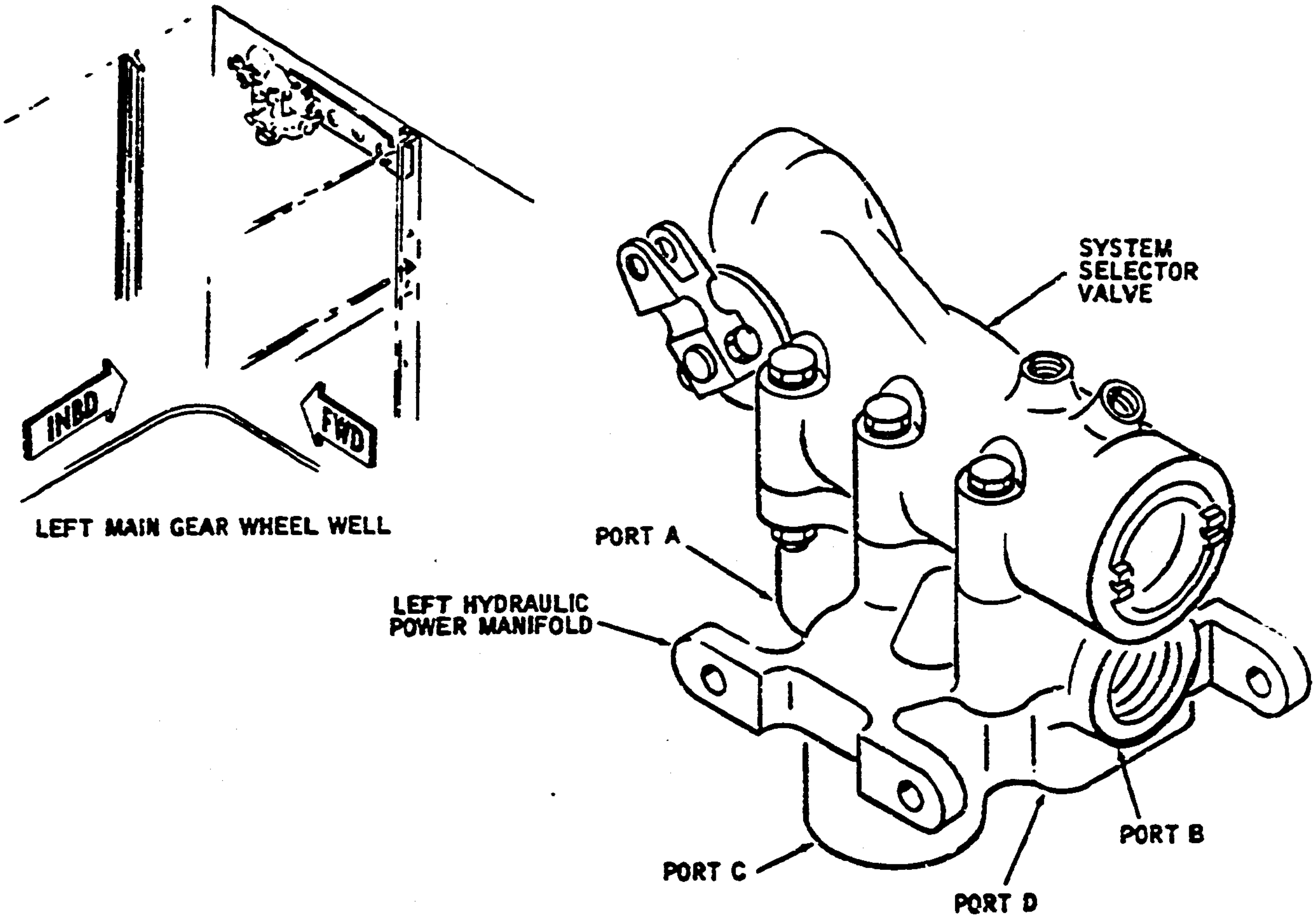
(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

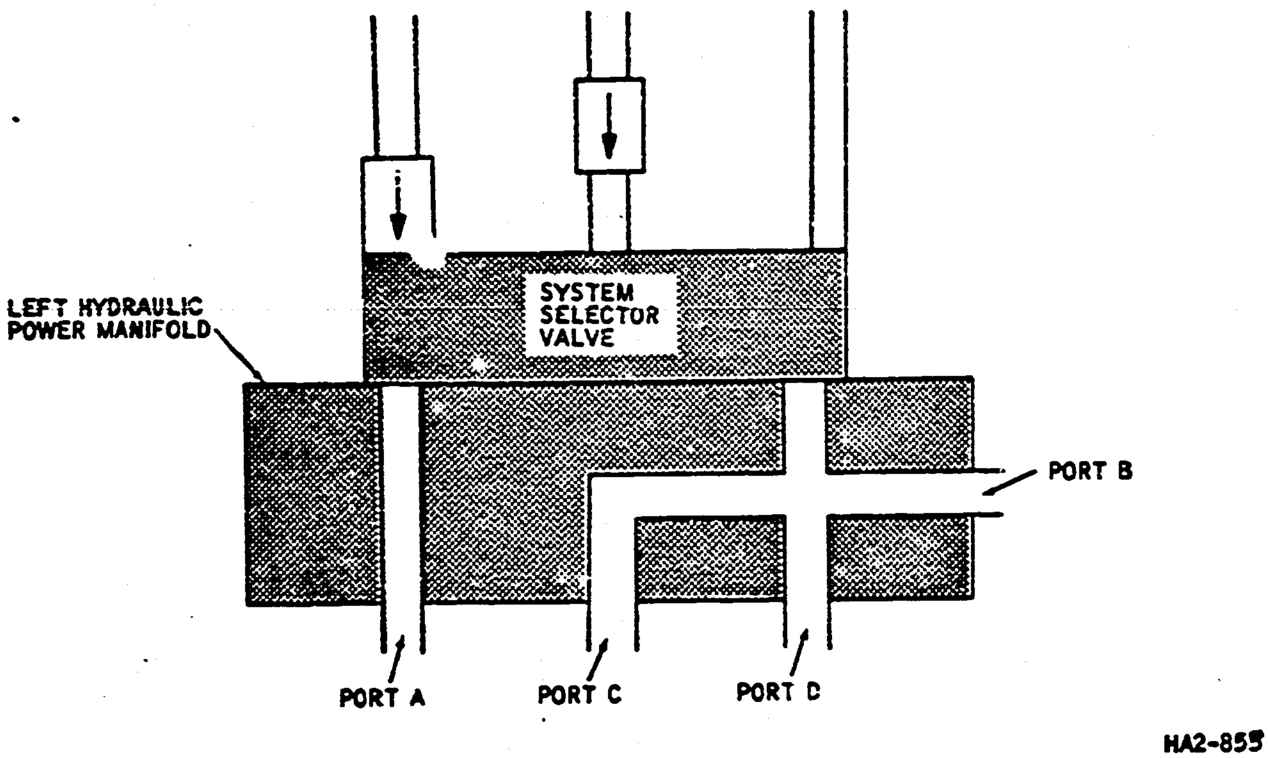
Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

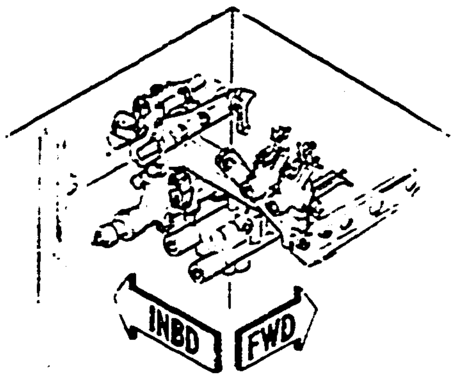
(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

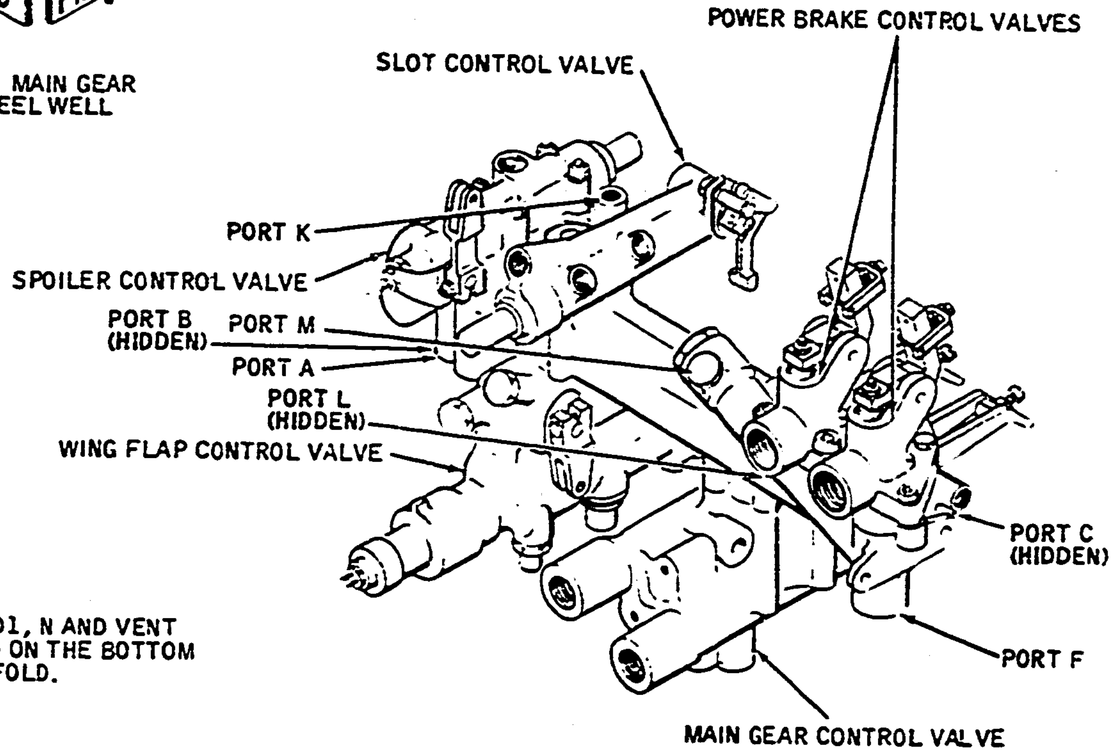




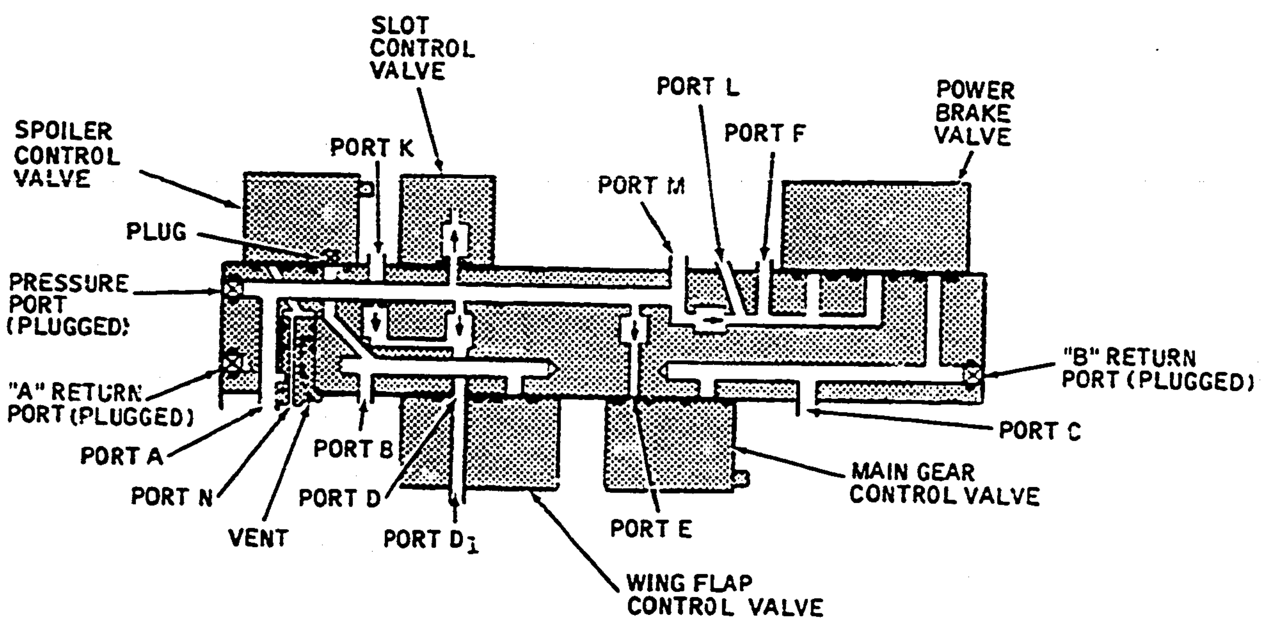
Left Hydraulic Power Manifold -- Schematic
Figure 18



RIGHT MAIN GEAR
WHEEL WELL



NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



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Right Hydraulic Power Manifold -- Schematic
Figure 19

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

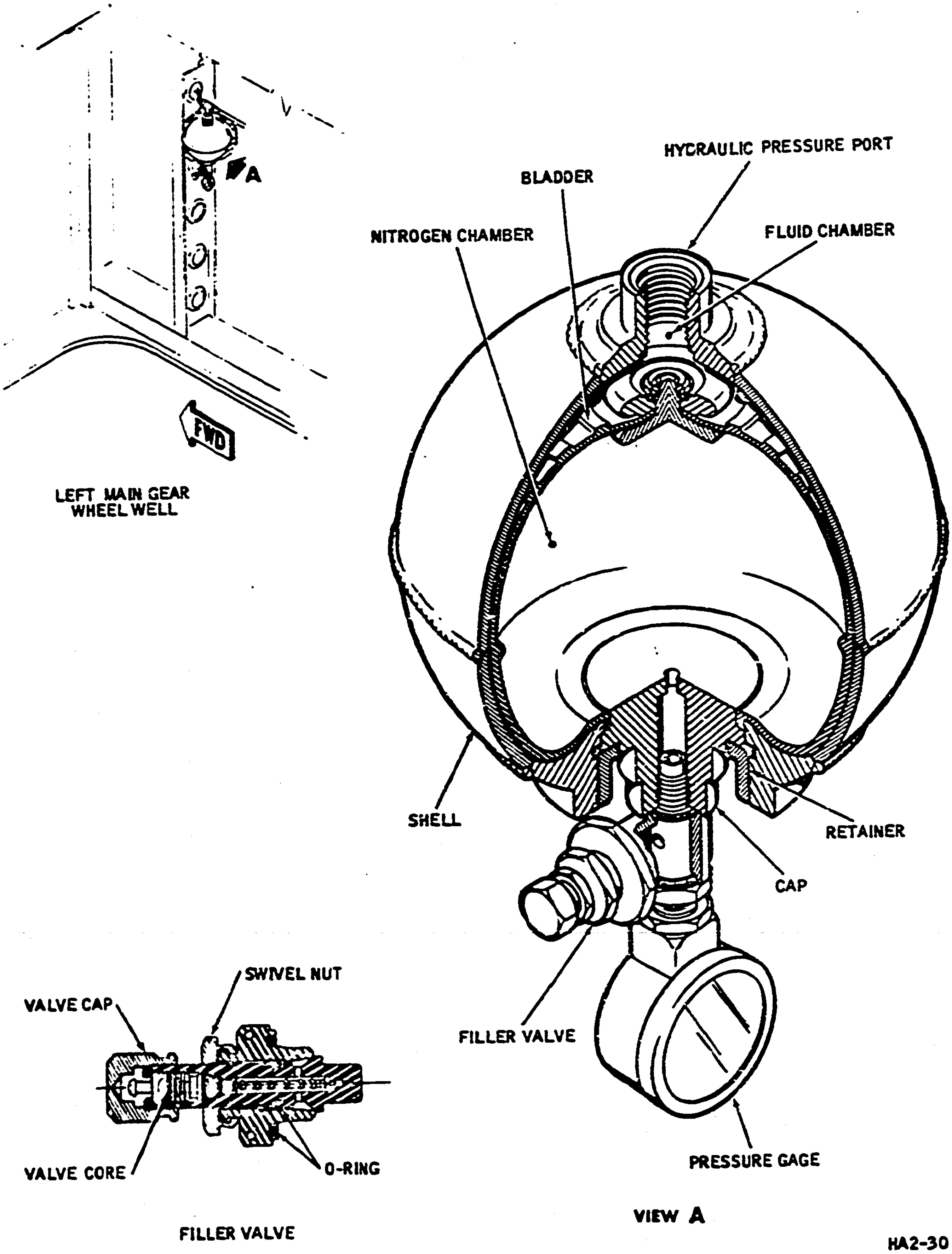
R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.



Hydraulic Power System Accumulator --
Cutaway View
Figure 20

T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

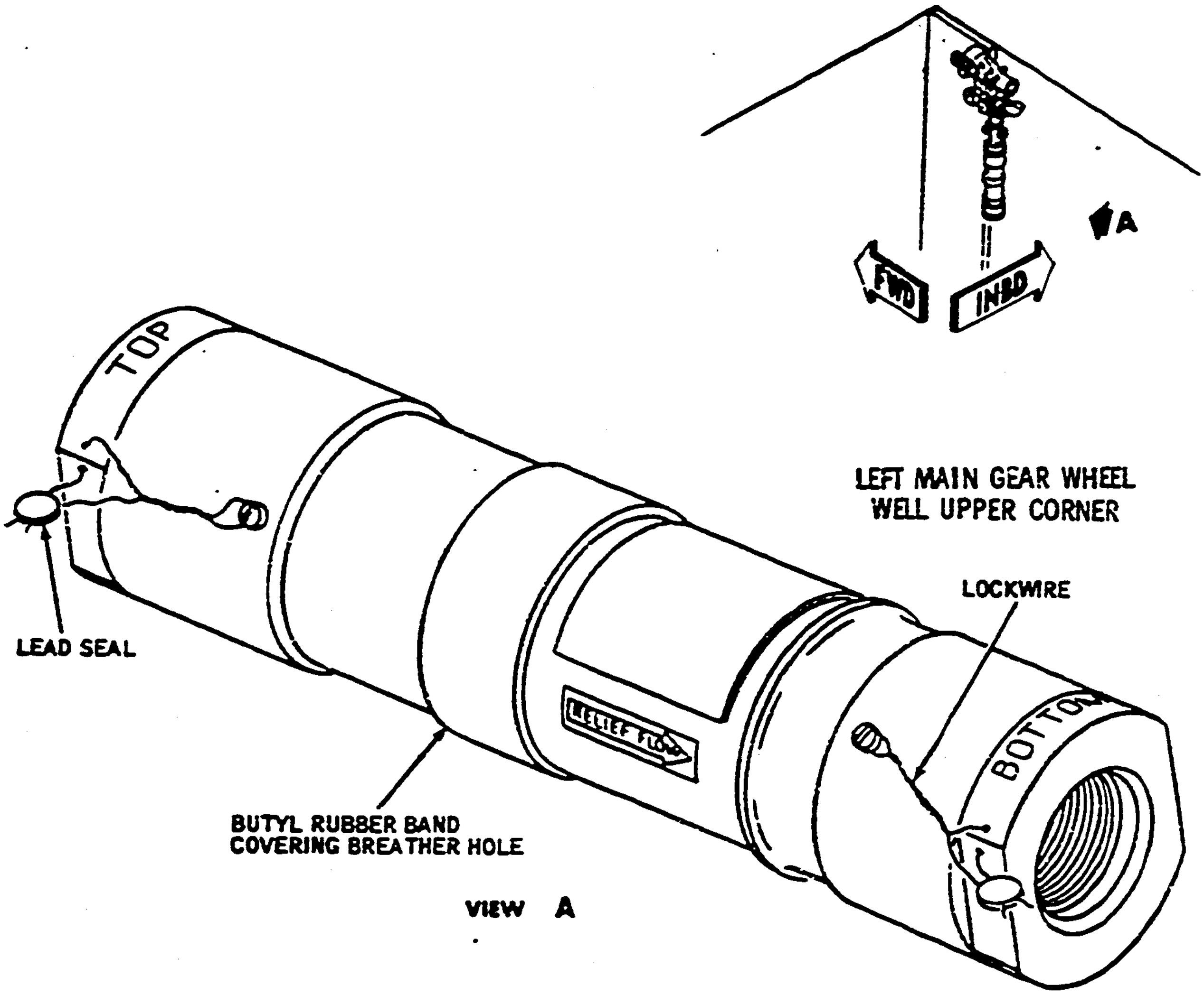
(c) Wing flaps down -- 8 gp (10 seconds)

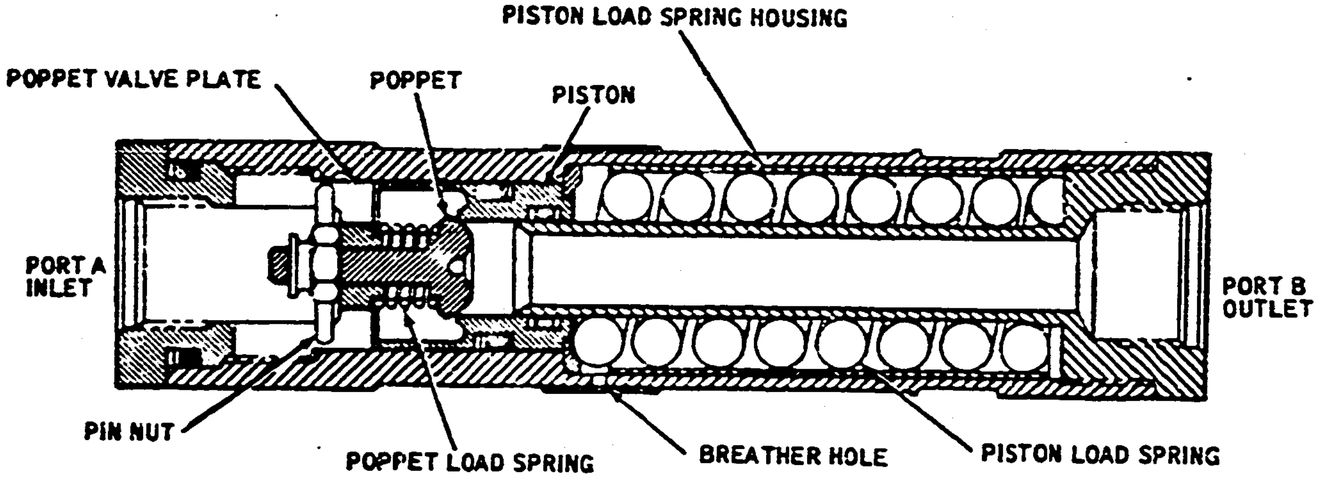
(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)





HA2-856

Hydraulic System Priority Valve -- Cutaway View
Figure 21

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

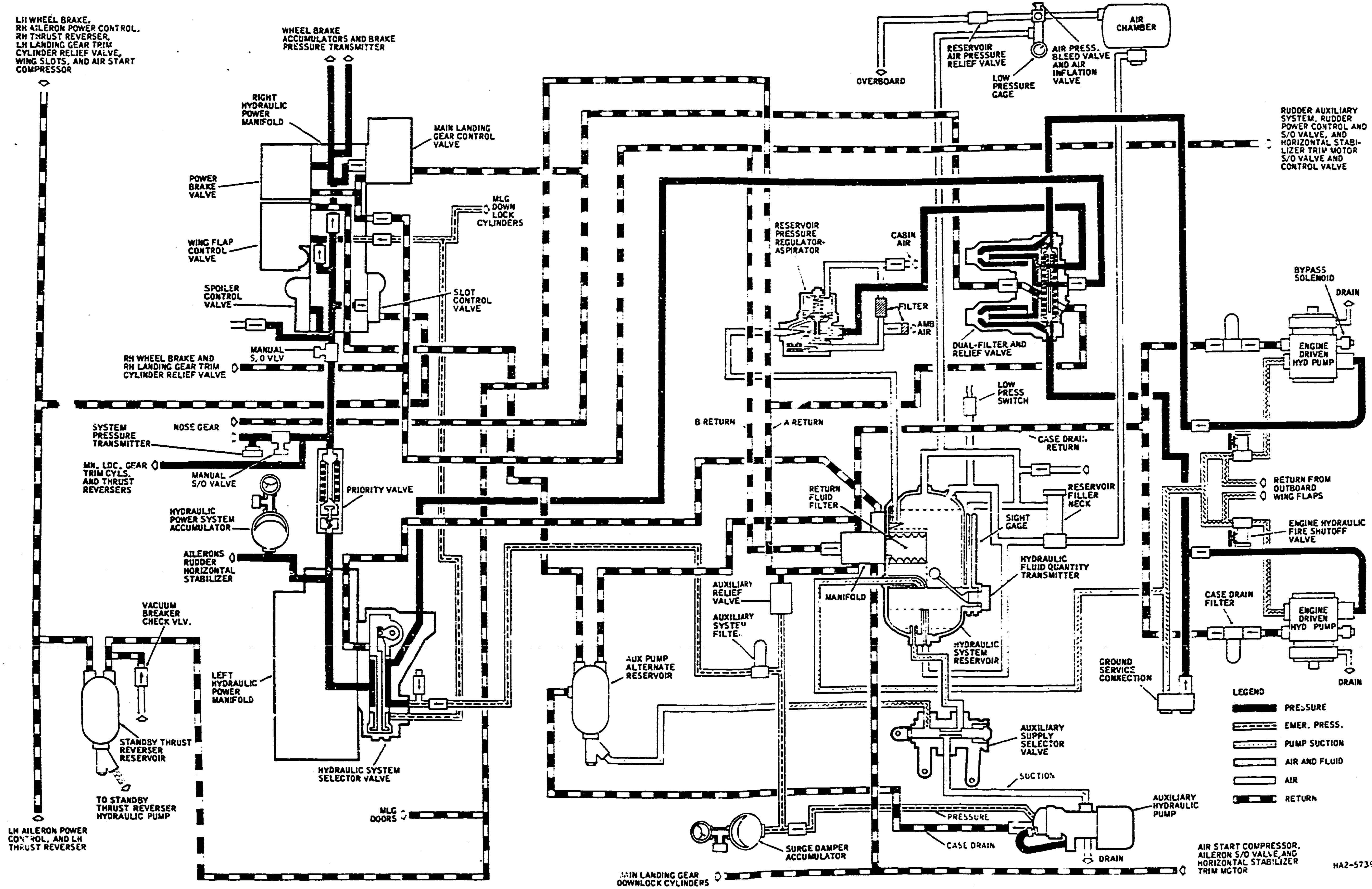
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve.



Hydraulic Power System -- Schematic Diagram
Figure 1

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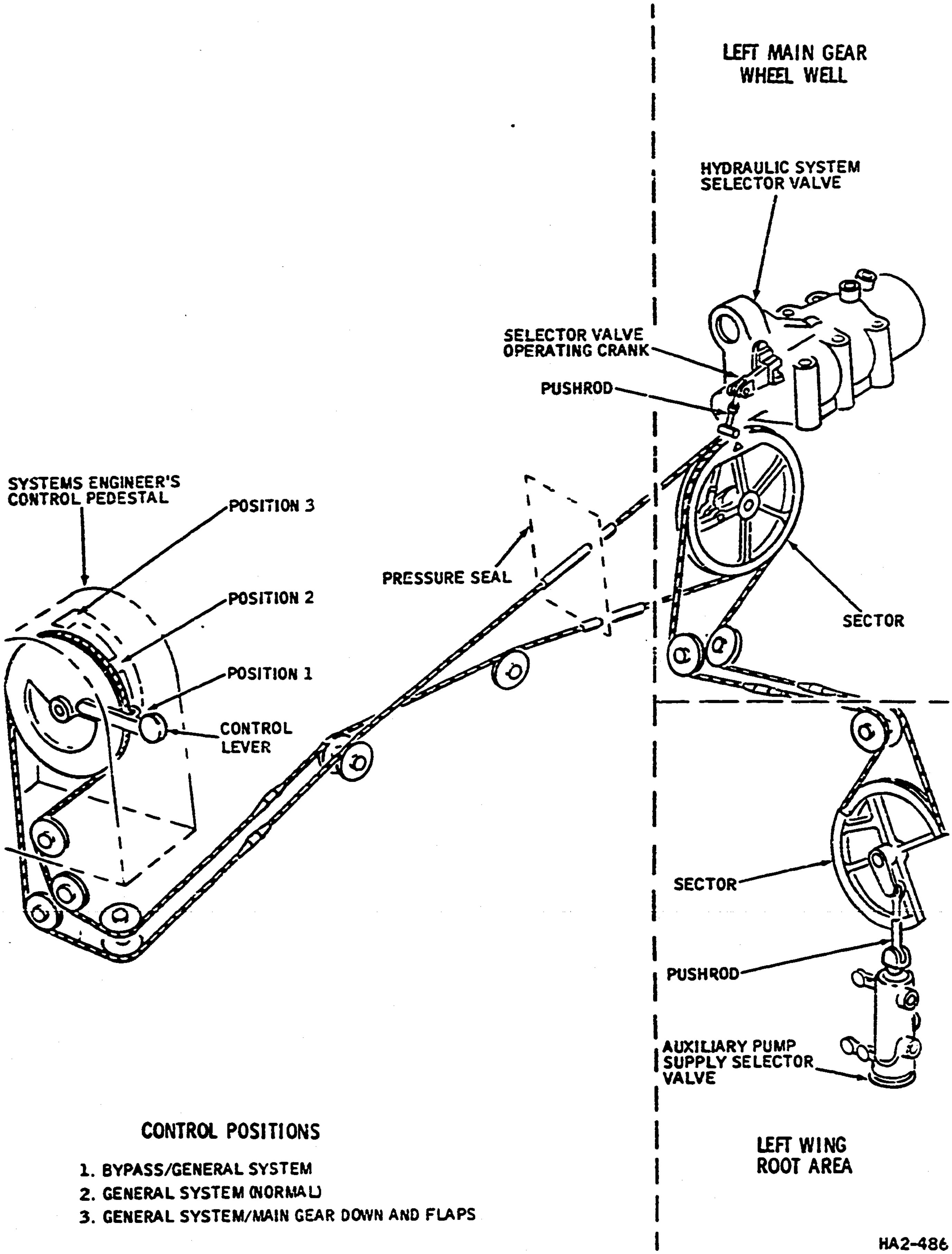


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure

bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve

sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

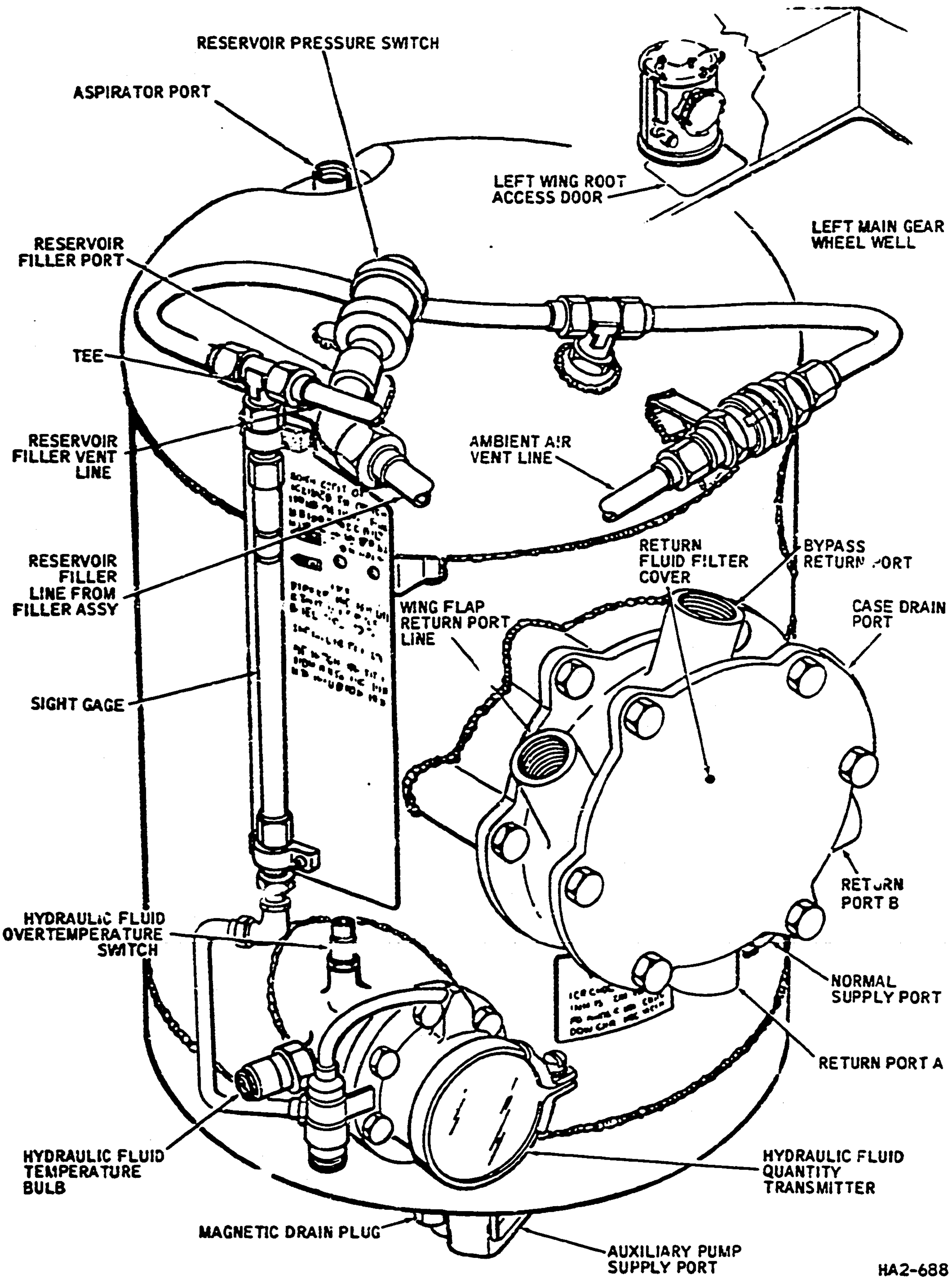
(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

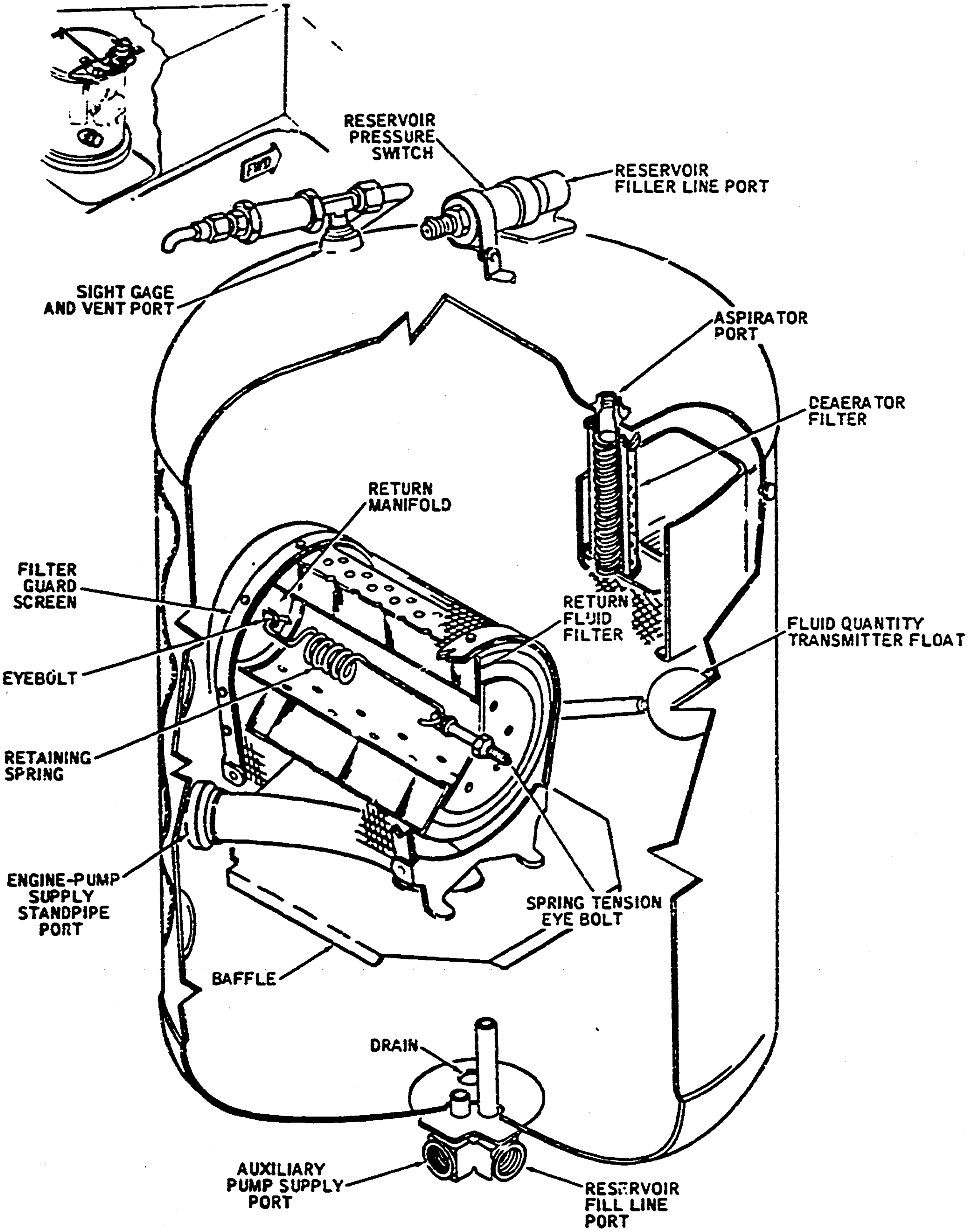
(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid



Hydraulic System Reservoir -- External View
Figure 3



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Hydraulic System Reservoir -- Cutaway View
Figure 4

temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

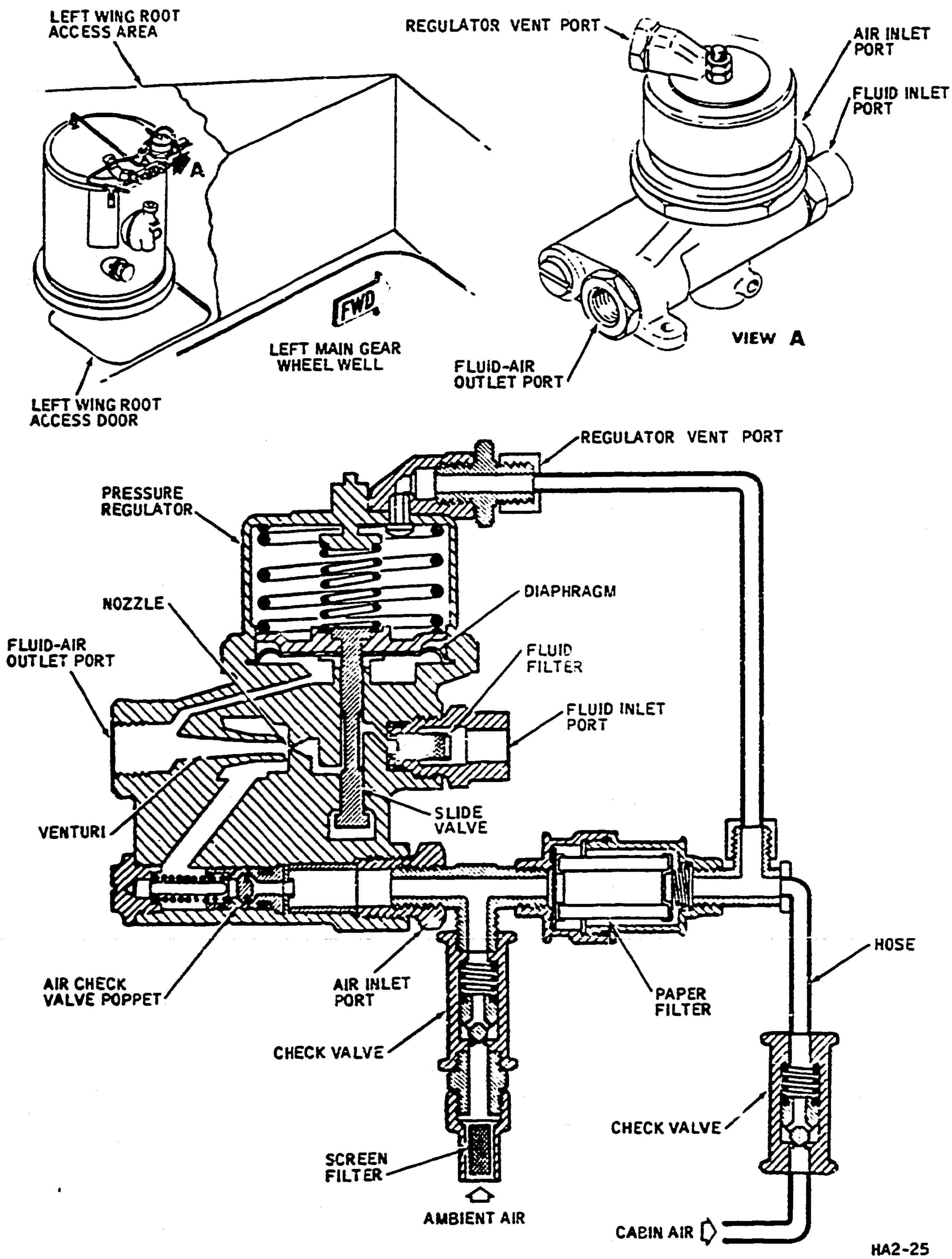
(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet plug. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

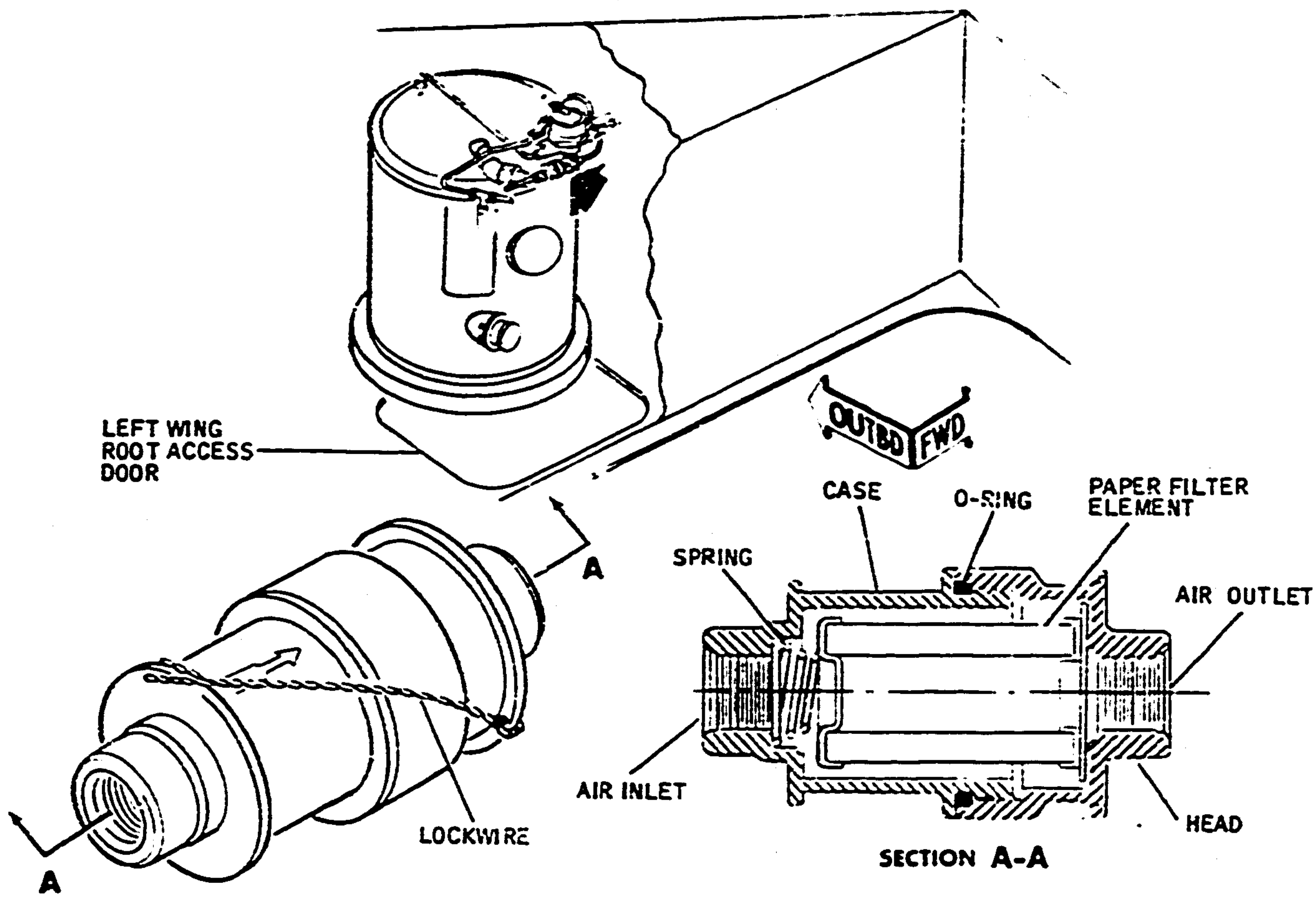
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

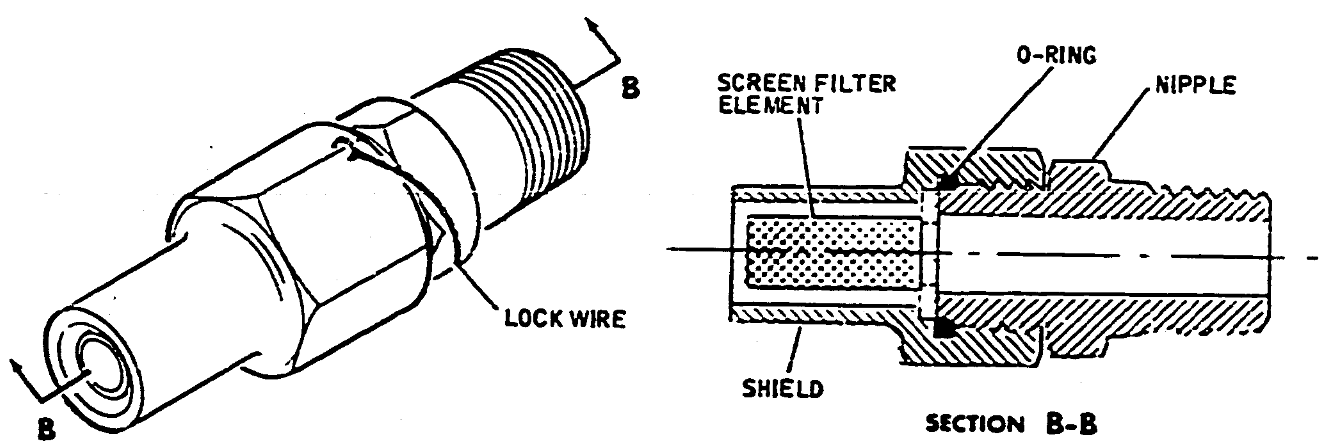
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system



PAPER ELEMENT FILTER



SCREEN FILTER

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Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The outer filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

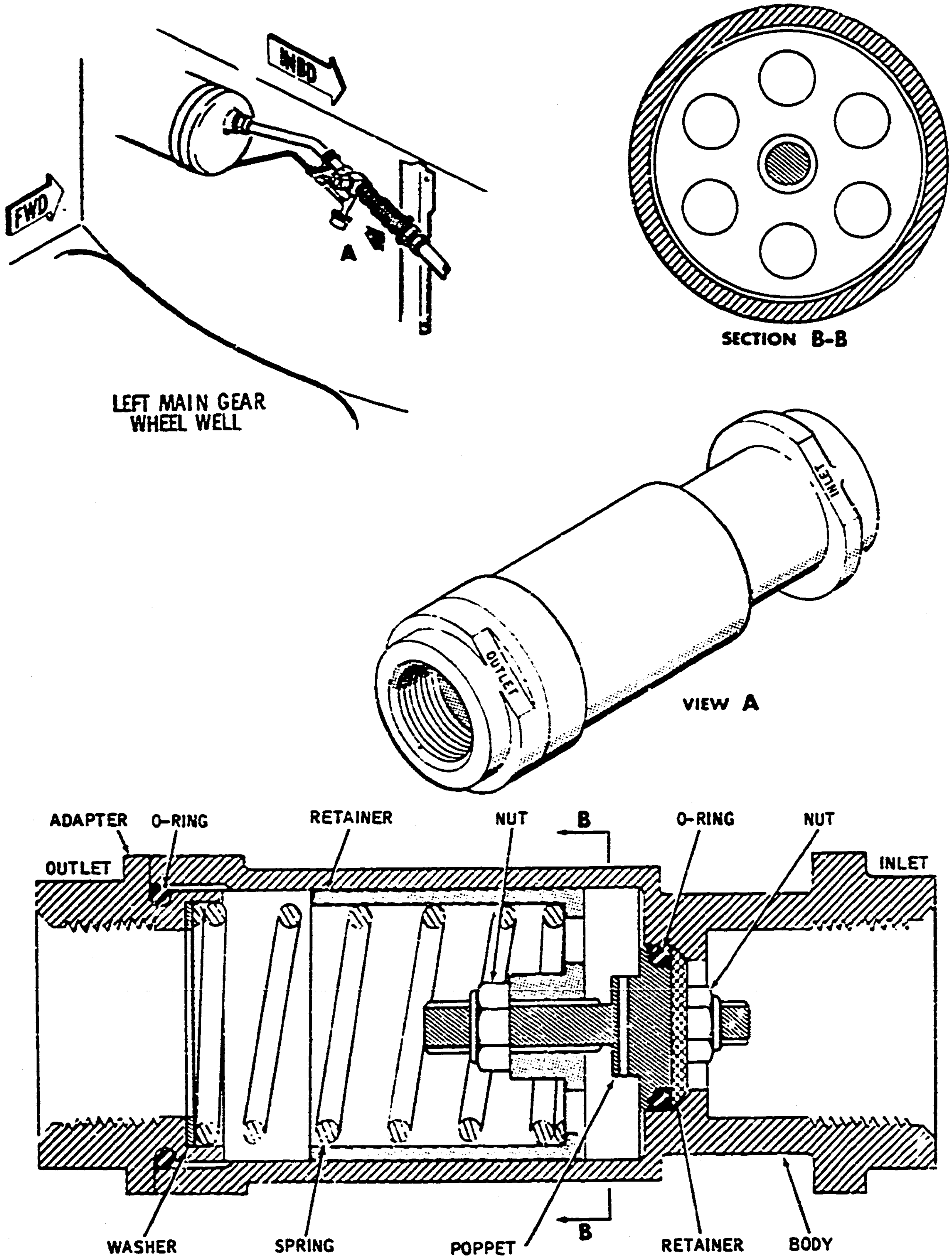
(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the



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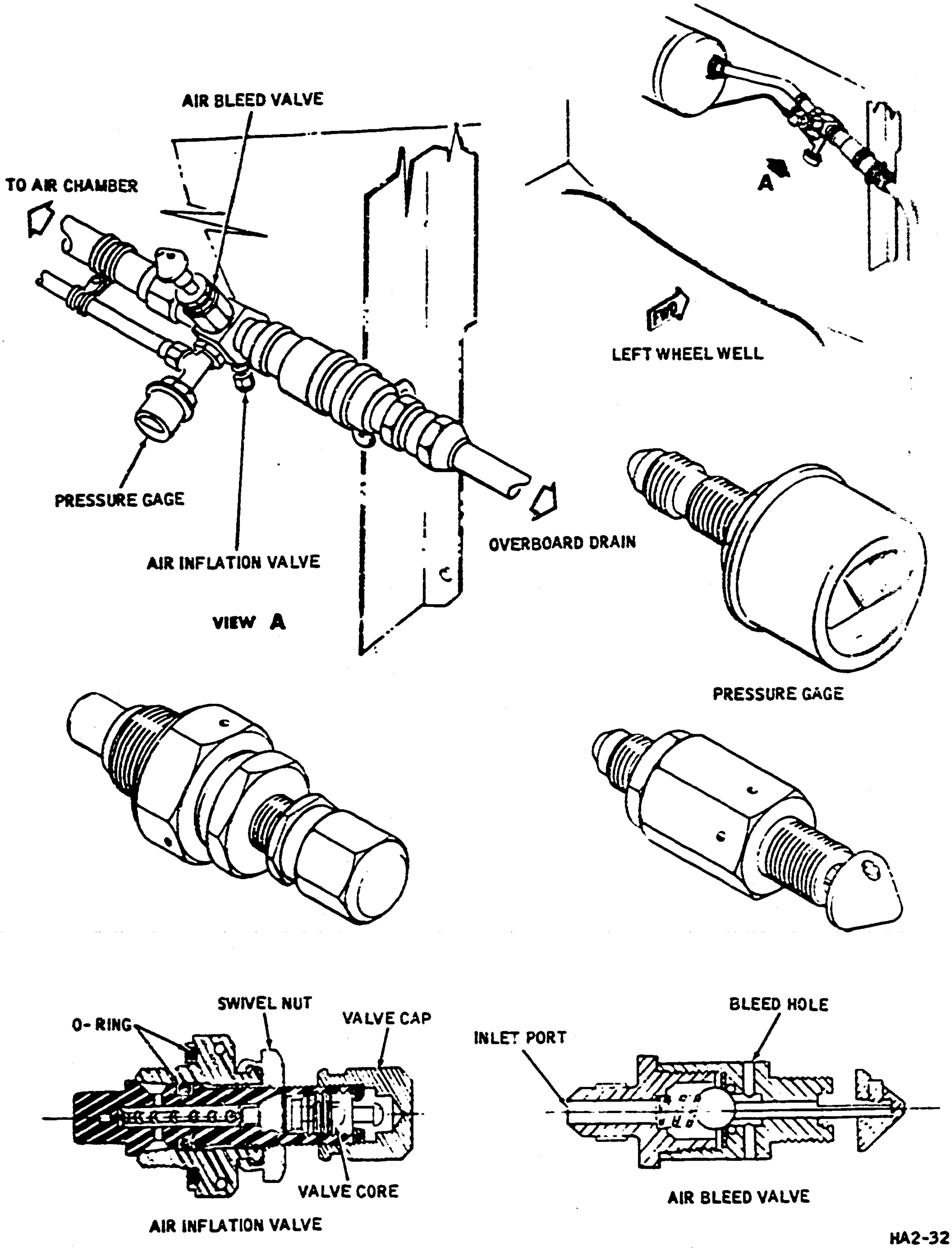
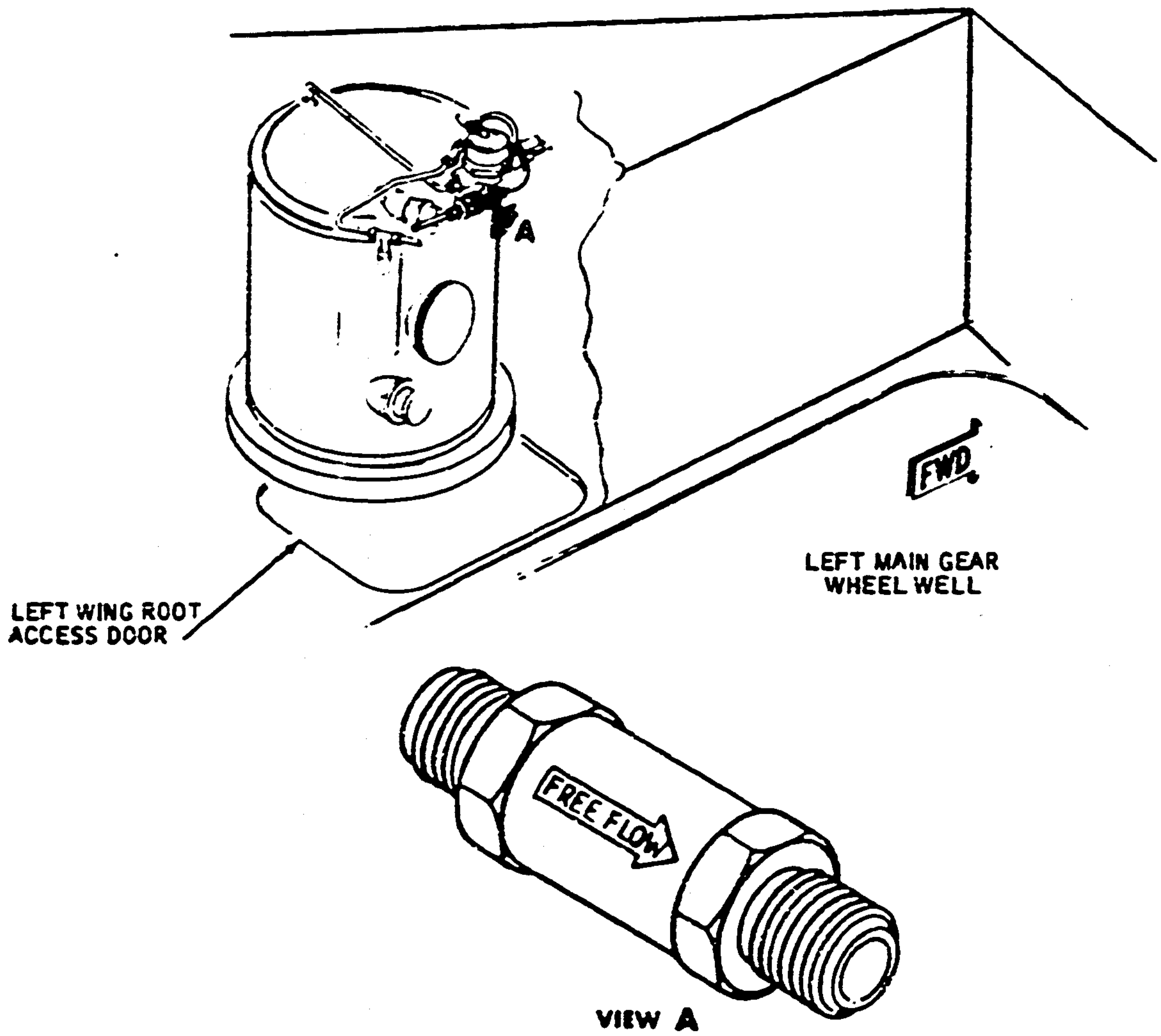
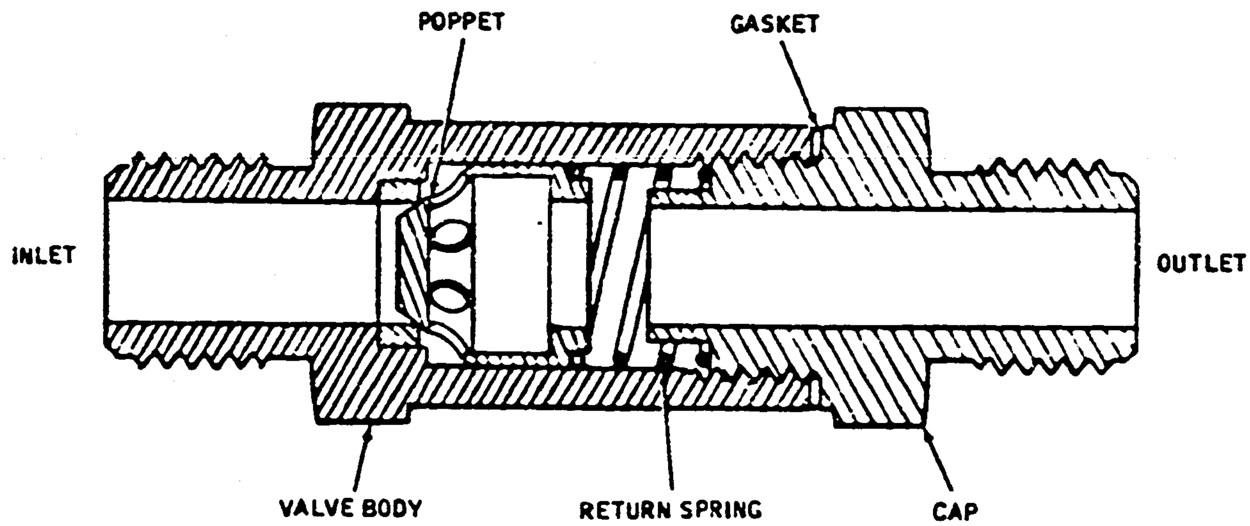
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8





Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

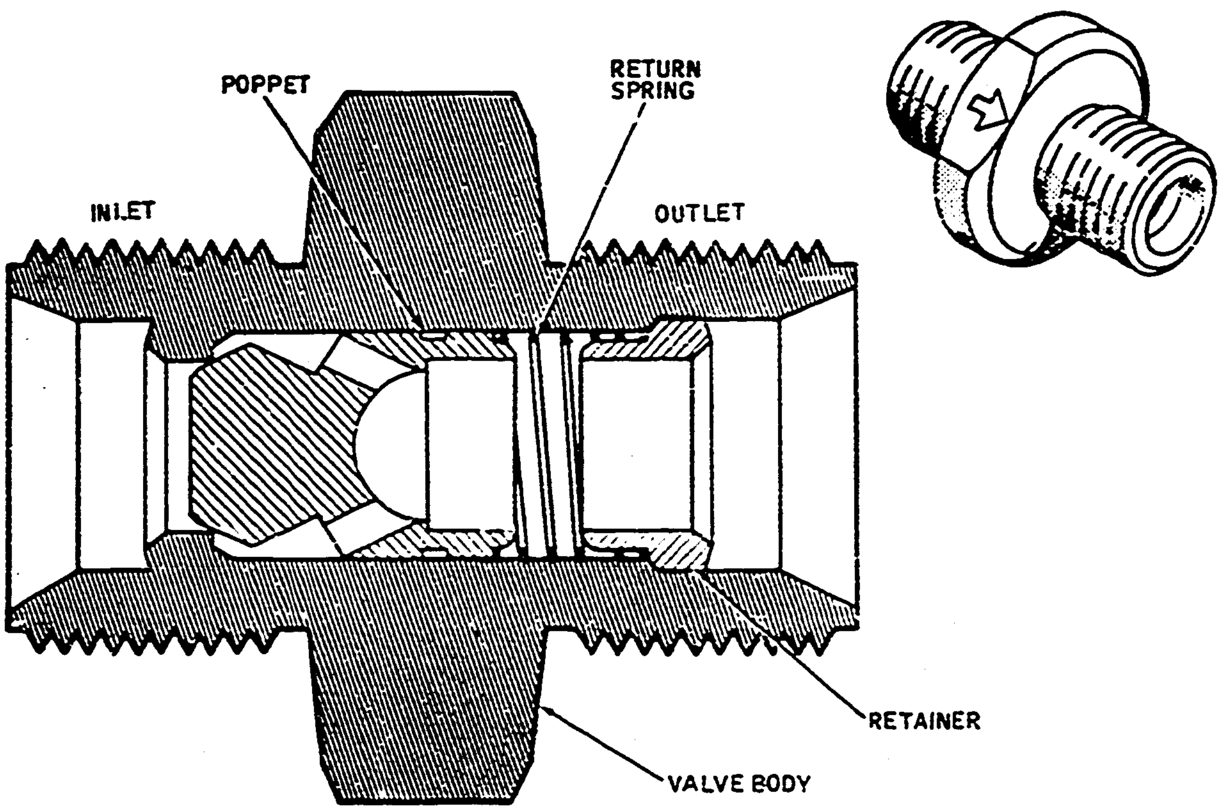
(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

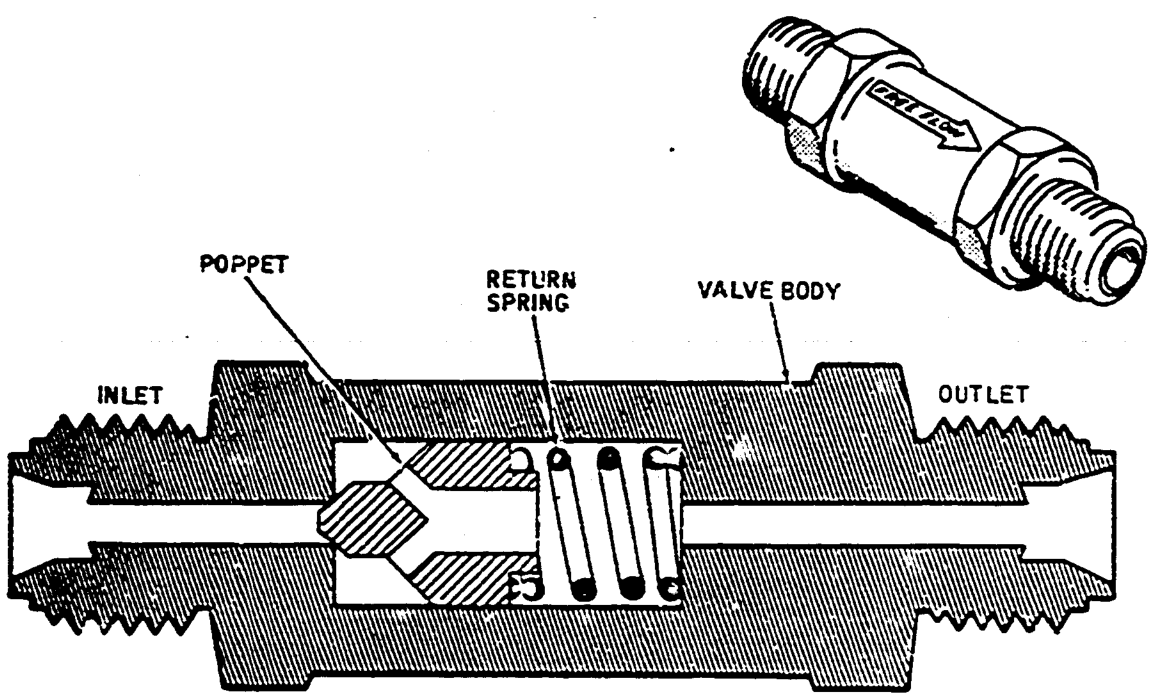
J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access



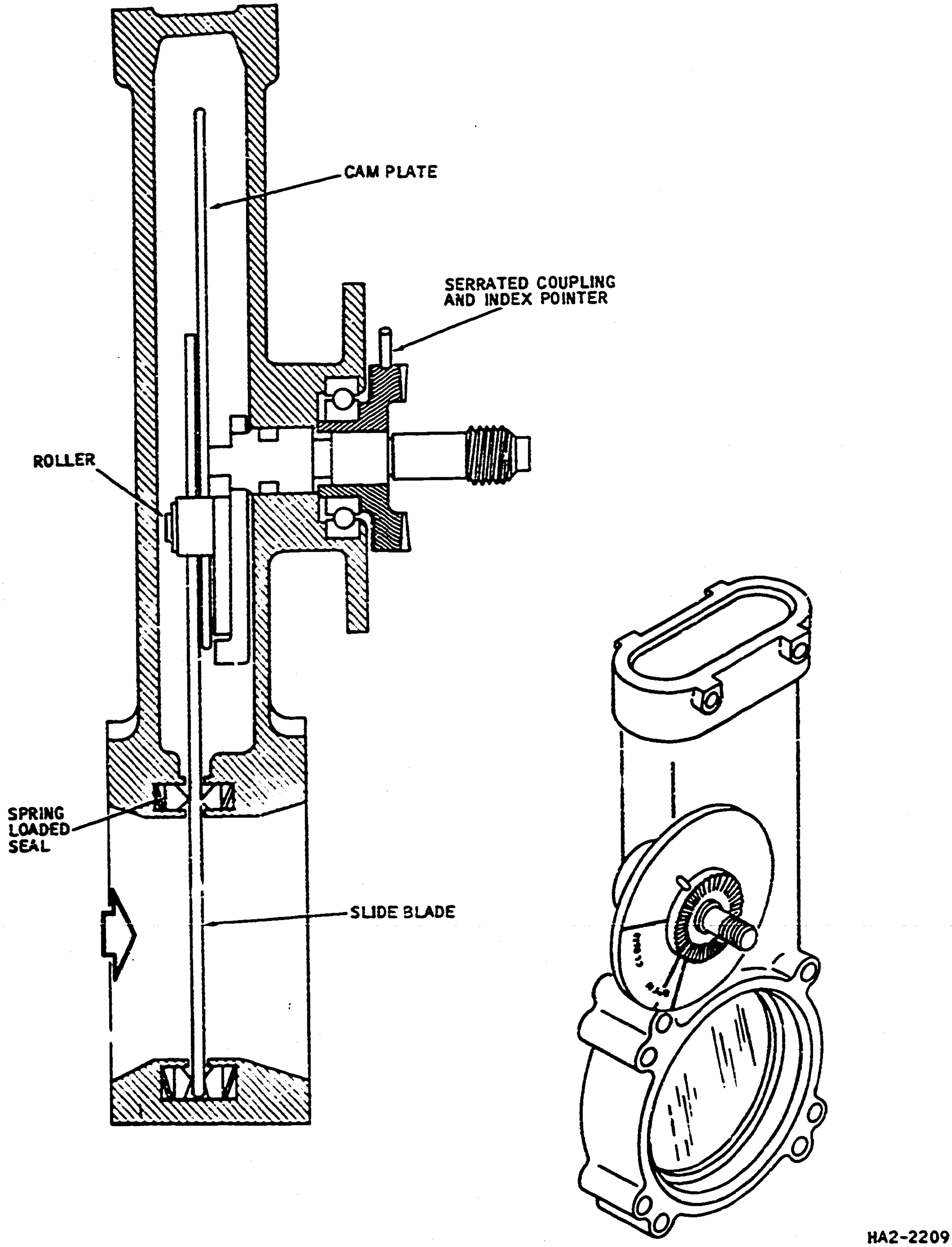
MINIATURE CHECK VALVE



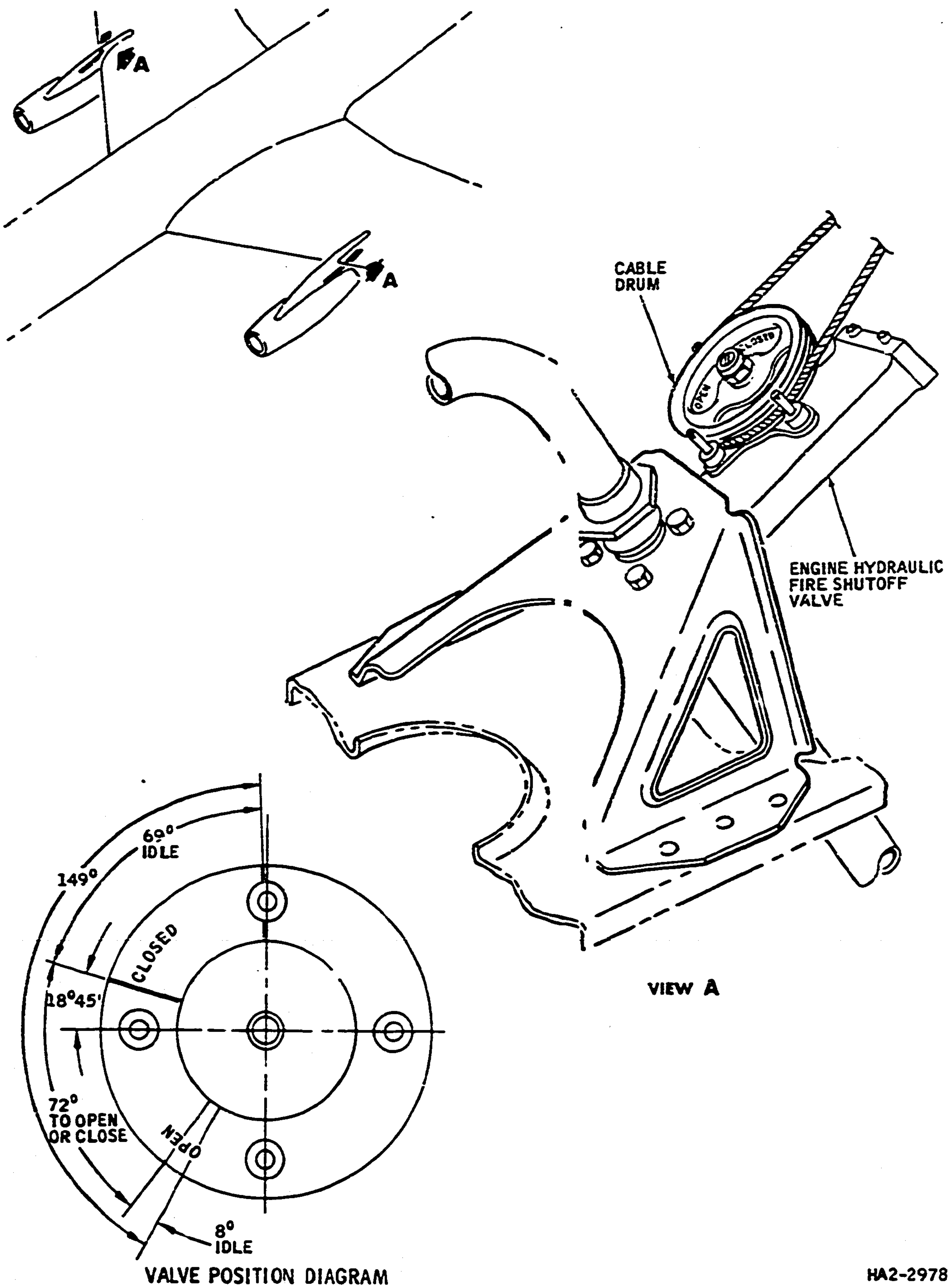
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

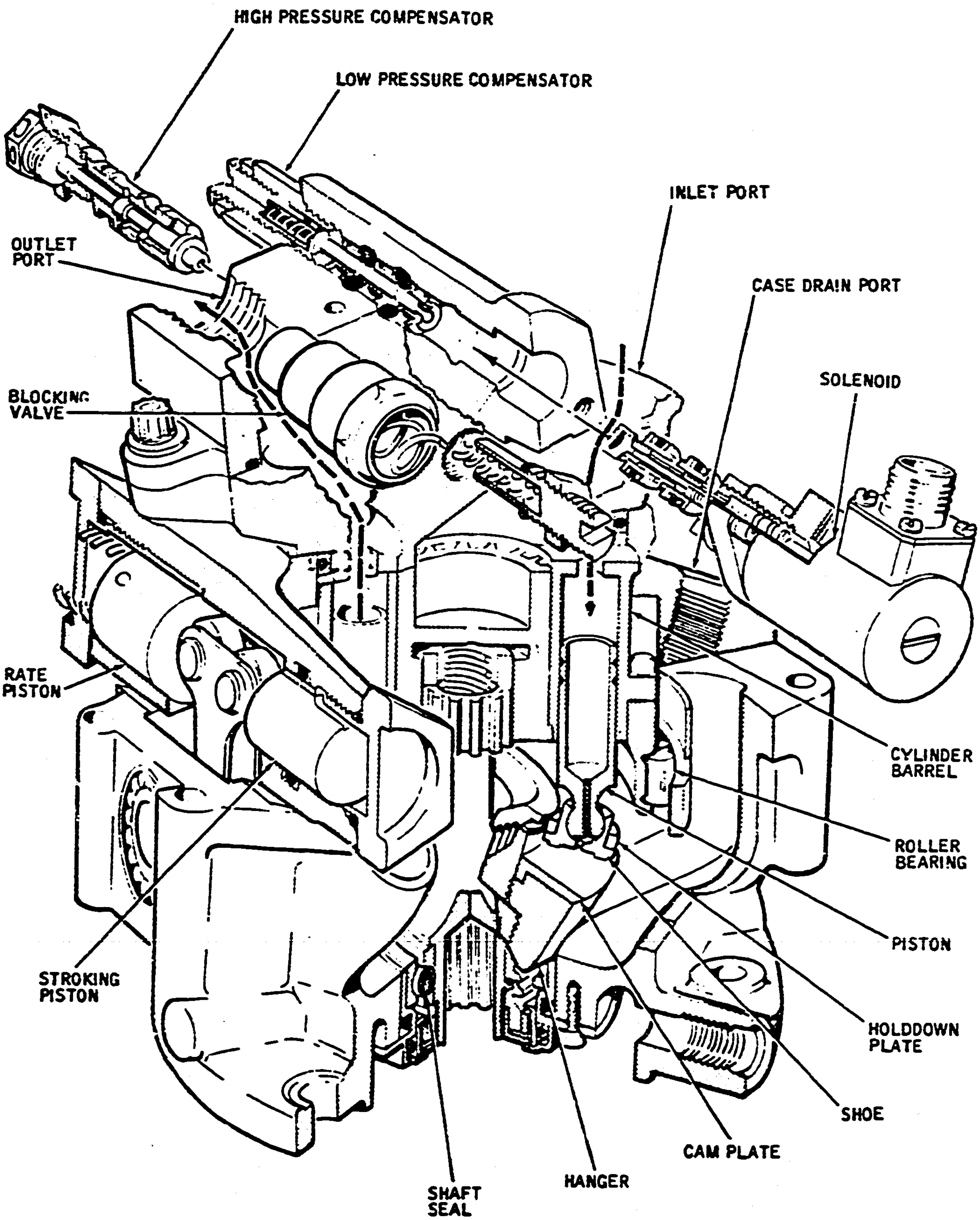
(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

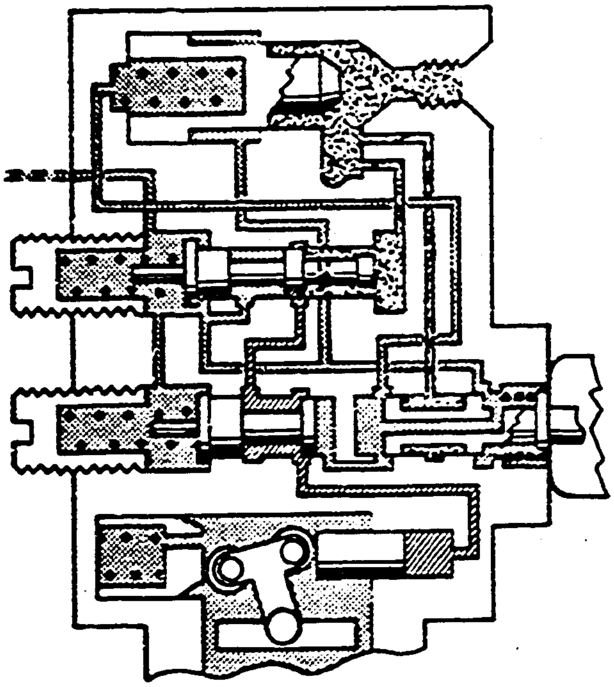
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figures 13 and 14.)

(1) The two, single-stage, variable-displacement, cam-actuated, pressure-compensated, engine-driven hydraulic pumps are installed, one each, on the inboard engines. The pump incorporates a solenoid-operated bypass feature for reducing the output pressure to zero psi. Each bypass valve solenoid is controlled by a corresponding engine hydraulic pump control switch in the flight compartment. The switch for the hydraulic pump on engine 2 is placarded left, on, and bypass. The switch for engine 3 is placarded right, on, and bypass. When a switch is placed in the bypass position, the bypass valve for that pump is actuated and the pump pressure is reduced to zero psi. When the switch is placed in the on

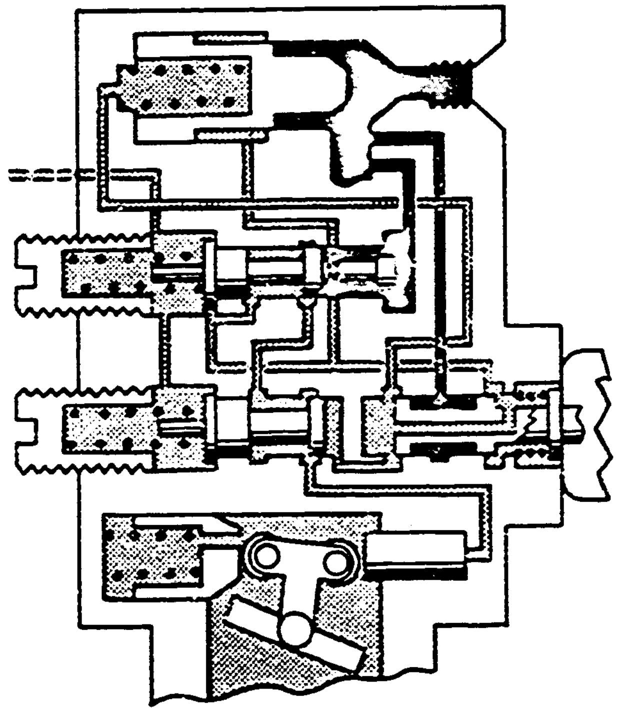


Engine-Driven Hydraulic Pump -- Cutaway View
Figure 13



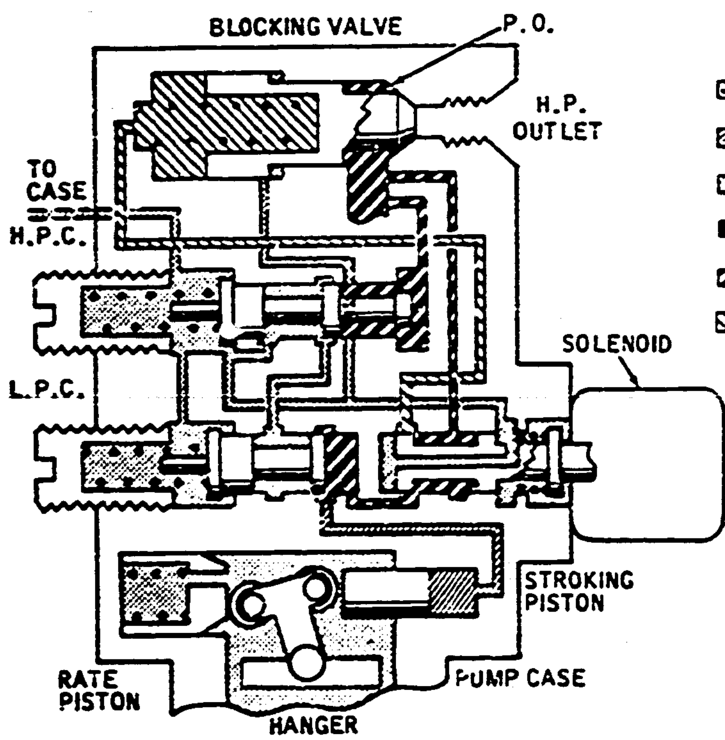
A. FULL PRESSURE, NO FLOW CONDITION

BLOCKING VALVE OPEN, 3,000 PSI FLUID AVAILABLE, NO DEMAND.



B. FULL FLOW CONDITION

BLOCKING VALVE OPEN, HANGER "ON STROKE" 3,000 PSI FLUID FLOWING FROM PUMP.



C. DEPRESSURIZED AND BLOCKED CONDITION

SOLENOID ENERGIZED, BLOCKING VALVE CLOSED, PUMP COMPENSATED AT 500 PSI.

KEY

- COMPENSATED PRESSURE: 3,000 ± 50
- CONTROL PRESSURE: 200-300
- CASE PRESSURE: 45-55
- FULL FLOW PRESSURE: TO 2,950
- DEPRESSURIZED PRESSURE: 400-500
- BLOCKING VALVE PRESSURE: 400-500
- P.O. = PUMP OUTLET
- H.P.C. = HIGH PRESSURE COMPENSATOR
- L.P.C. = LOW PRESSURE COMPENSATOR

HA2-19

Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 14

position, the bypass valve is open and the pump operates normally in a pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system.

(2) The heart of the pump is a revolving cylinder barrel which contains nine pistons. By means of a hold-down plate and hydraulically balanced shoes, the pistons are supported on an inclined cam plate which causes them to reciprocate as the barrel revolves. The hold-down plate ensures positive stroking of the pistons during the suction stroke. The angle of the cam plate is varied by moving the trunnioned hanger on which it is mounted, thereby changing the displacement of the pump. The hanger, in turn, is controlled by a pressure compensator.

(3) Oil passes through the main inlet and then through porting in the end of the cylinder barrel to the cylinders from which the pistons are being withdrawn. As the cylinder barrel revolves, these pistons are forced into their bores and discharge high-pressure oil through porting in the end of the barrel to the outlet port.

(4) The cylinder barrel, supported by a radial bearing, is driven by an internal shaft which passes through the trunnioned hanger. A hydraulically balanced, face-type, carbon shaft seal is used to assure optimum sealing. Sealing pressure increases as case pressure increases, and the seal adjusts itself to compensate for any wear which takes place.

(5) The pressure compensator regulates the volume delivered in accordance with the demand of the system and maintains the predetermined pressure. When the pressure is less than the spring load, the spring moves the spool to vent oil in the stroking cylinder to the case. The stroking piston then retracts and a spring load on the hanger moves it to a greater angle and increases the volume pumped. The axial thrust of the pistons against the cam plate during power stroke is balanced hydraulically. Oil, at system pressure, is admitted through holes in the piston and shoe to an undercut area in the face of the piston shoe. The pressure applied to the undercut area, which is slightly less than the piston area, effectively balances the forces so that the shoe is supported on an oil film at all times. Balance is controlled to such a degree that there is no excessive leakage, and high volumetric efficiency is maintained.

(6) The axial thrust of the cylinder barrel is also balanced hydraulically against the port plate.

(7) Because of these features, the axial thrust of the pistons is transferred hydraulically, eliminating the need for antifriction thrust bearings. This increases the reliability factor, if contamination or other adverse conditions exist.

(8) The pump functions as a standard, pressure-compensated pump, when the bypass solenoid is not energized. Energizing the solenoid allows the pump to compensate at a reduced, controlled pressure of approximately

500 psi. Also incorporated in the cap is a blocking valve. The valve shuts off the discharge flow from the pump, when the 500 psi compensating valve takes over as a result of the solenoid being energized. Hence, depressurizing the pump permits operation with the pump completely feathered at approximately 1/2 drive torque required at 3000 psi. The blocking valve is automatically controlled by the depressurizing valve. When the solenoid is energized, the blocking valve prevents flow from the pump discharge port. When the solenoid is deenergized, the blocking valve automatically opens as the pump builds up pressure to match the system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the pottet. This prevents reverse flow of hydraulic fluid through the pumps.

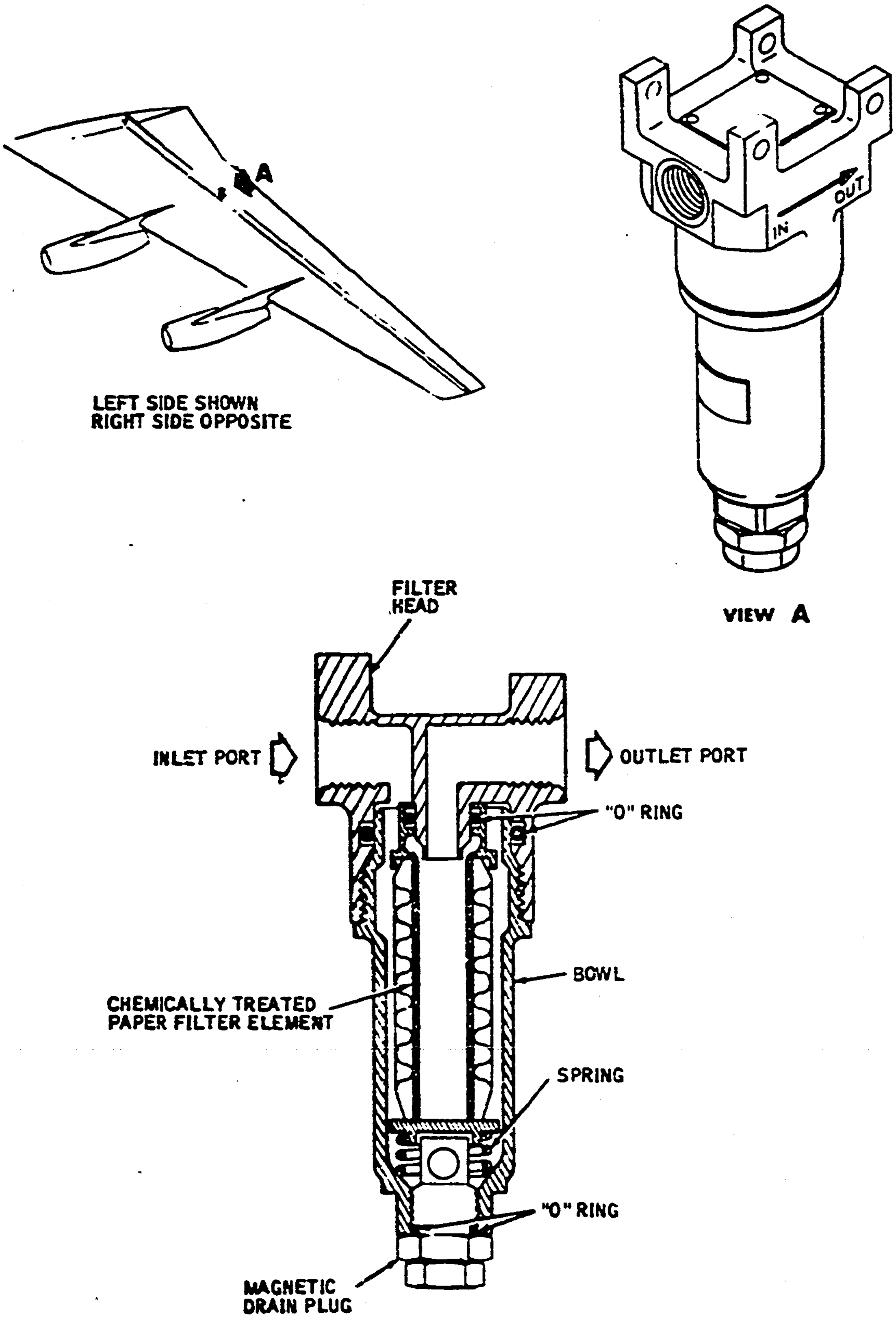
M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 15.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 16.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build



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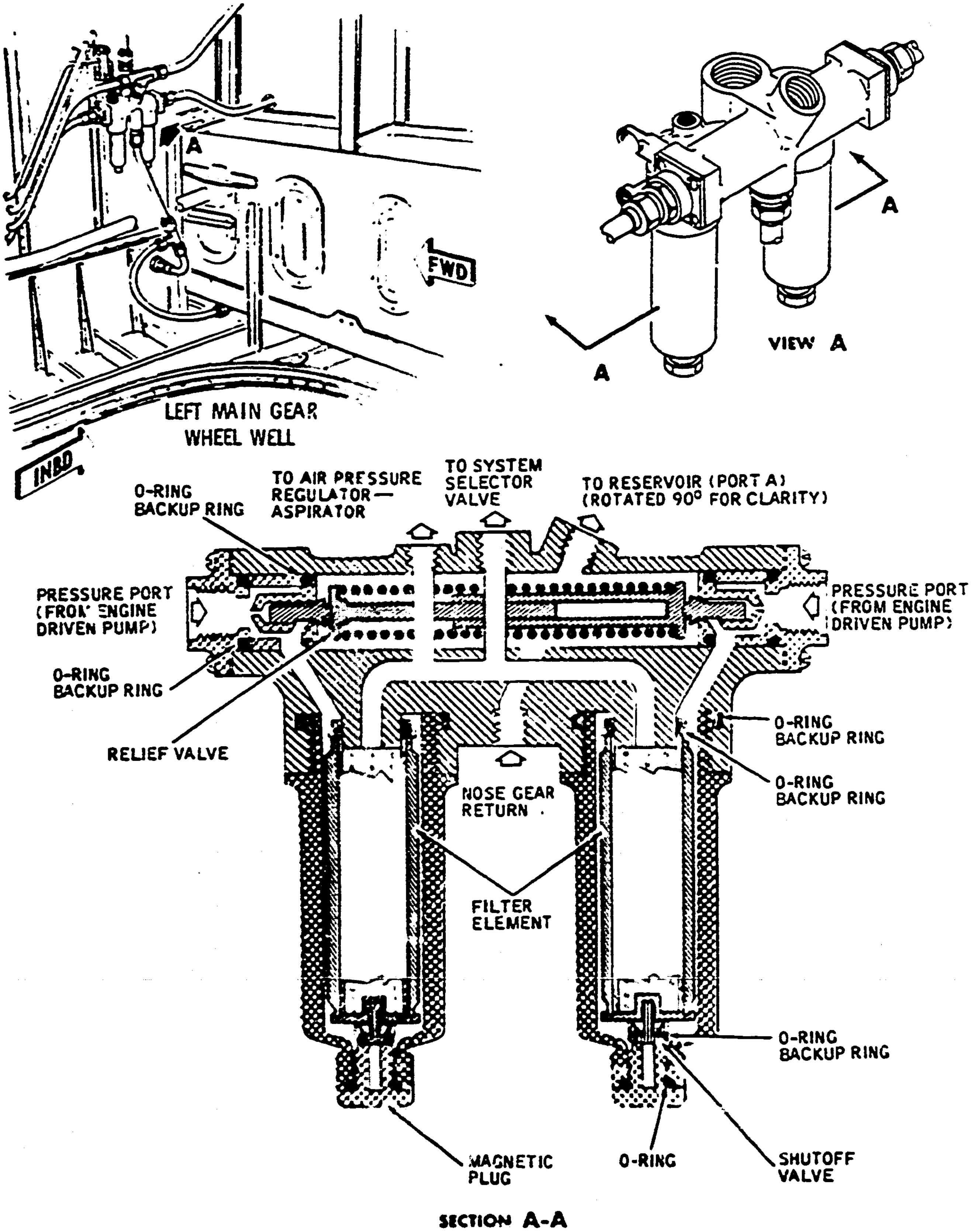
Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 15



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Dual-Filter and Relief Valve -- Cutaway Valve
Figure 16

up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

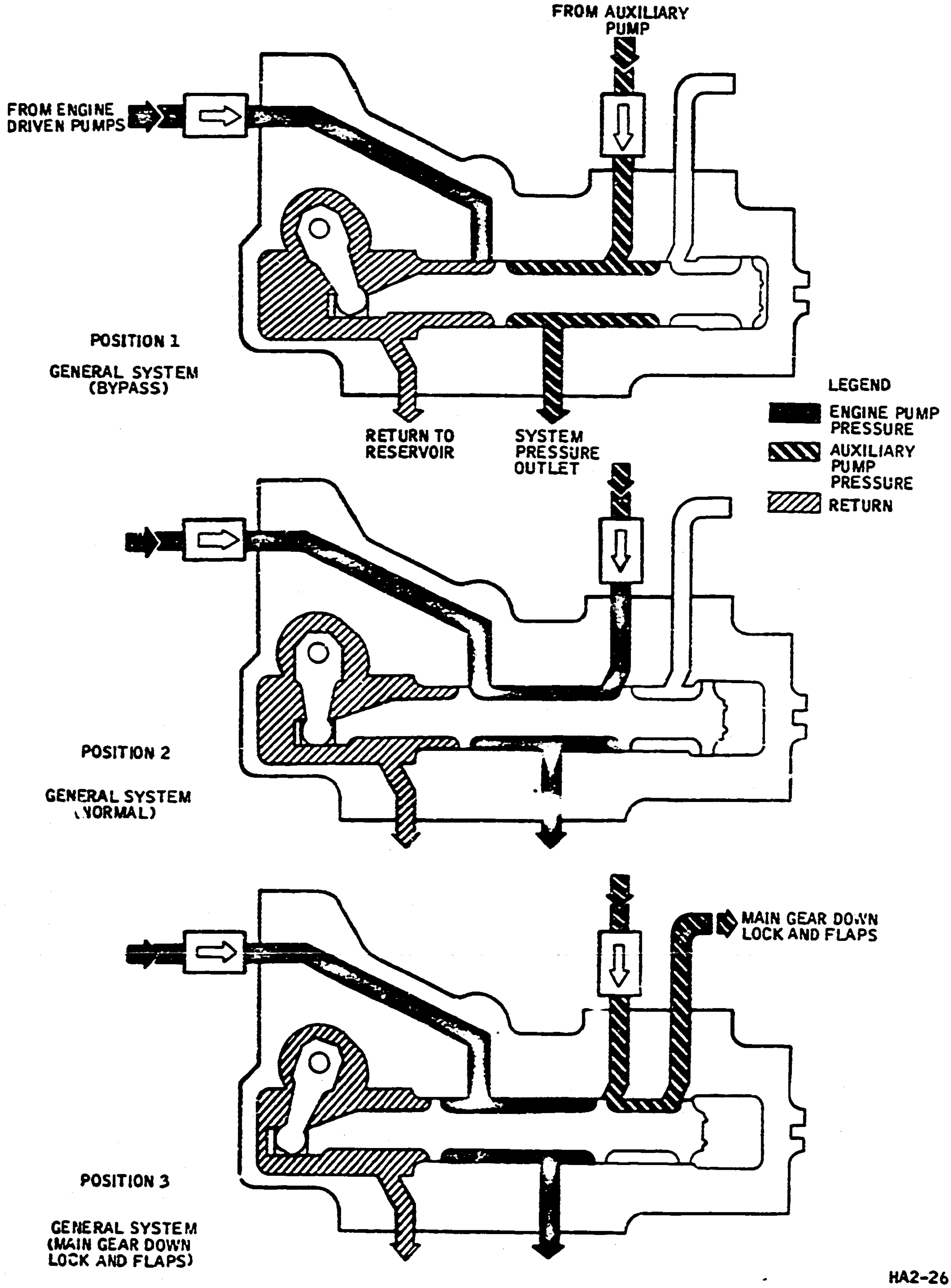
(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 17 and 18.)

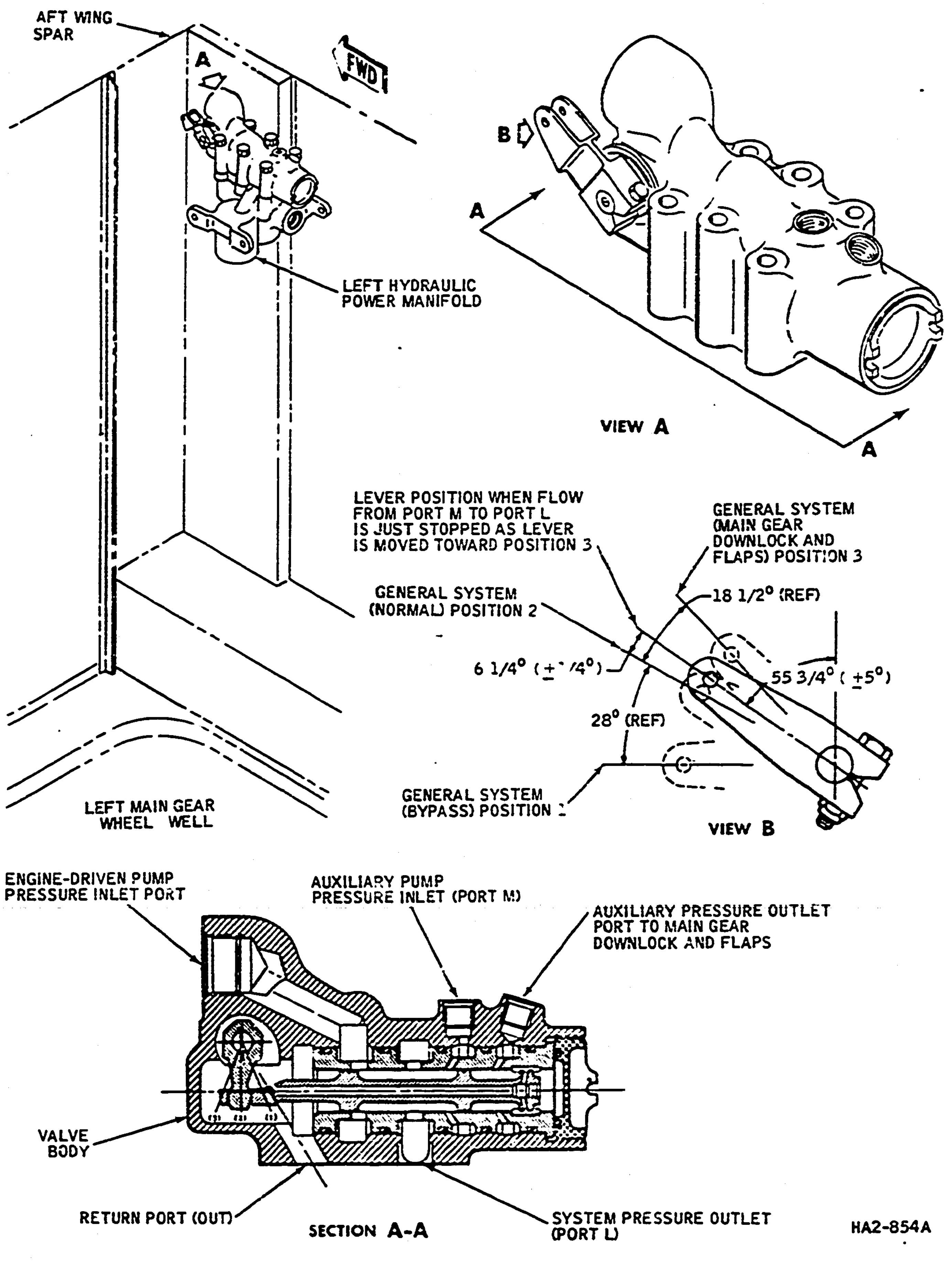
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal)



System Selector Valve -- Schematic
Figure 17



System Selector Valve -- Cutaway View
Figure 18

position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 19.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

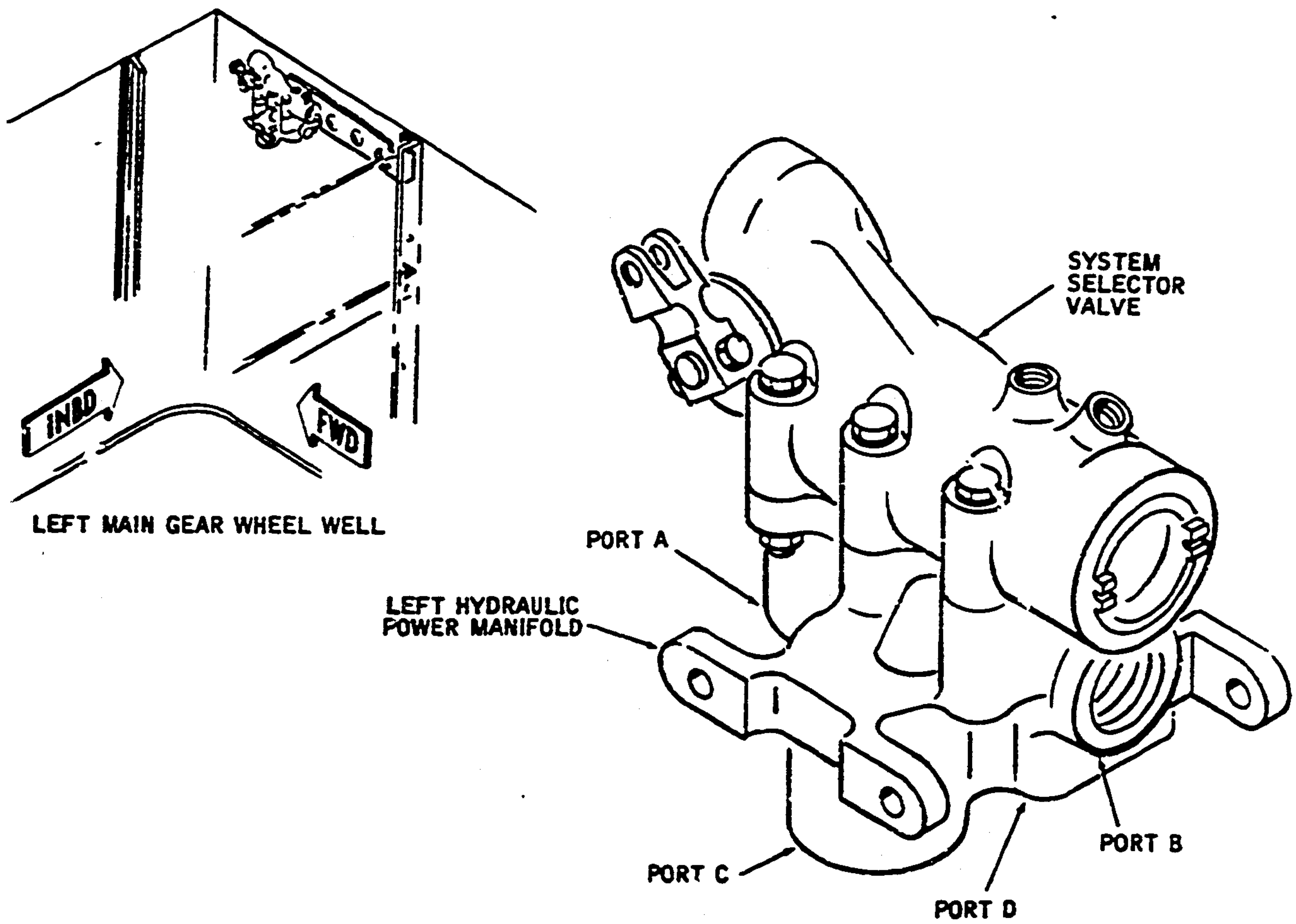
Q. Right Hydraulic Power Manifold (See Figure 20.)

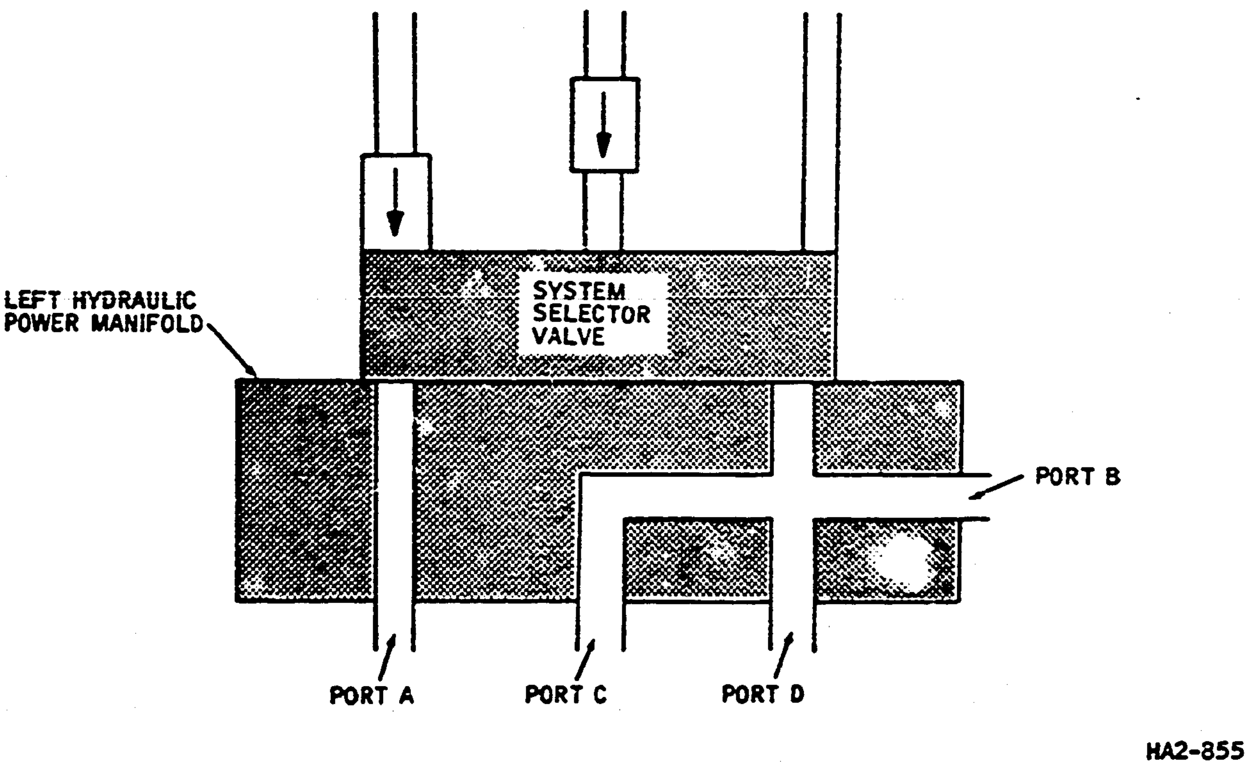
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

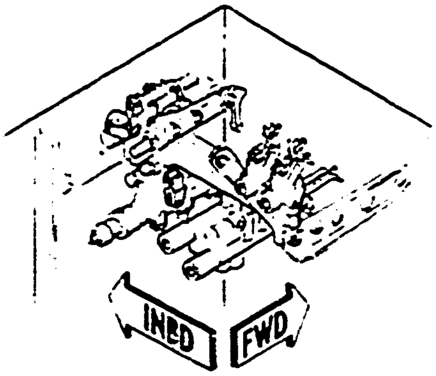
(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary

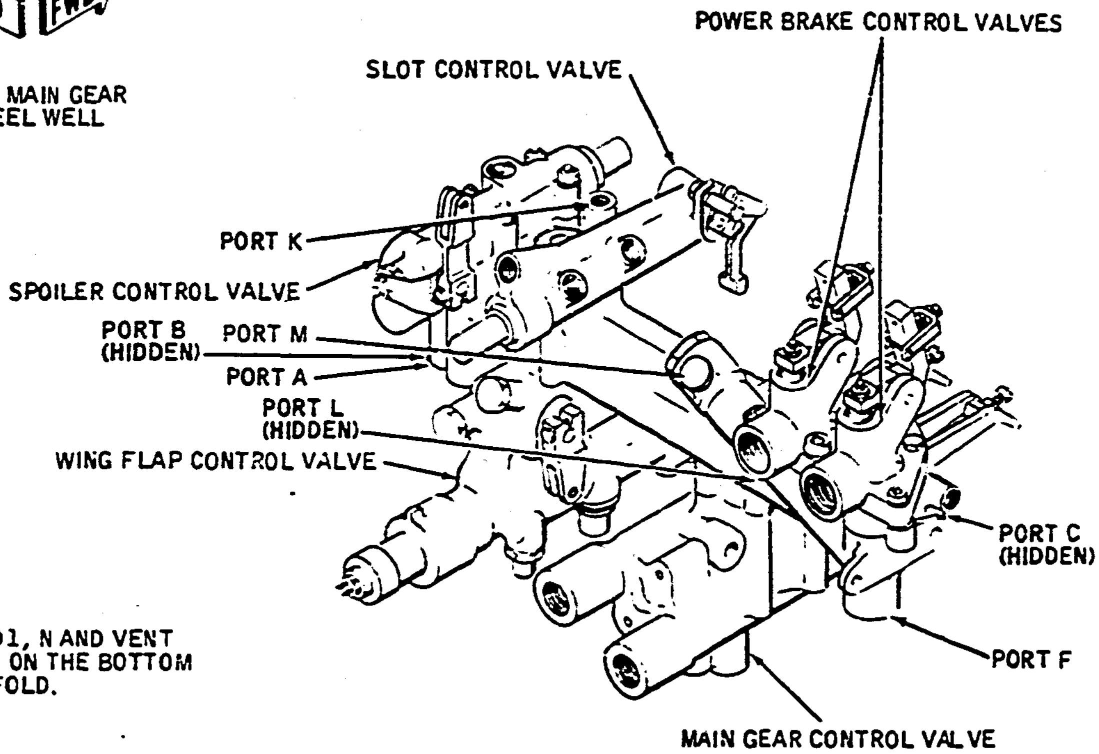




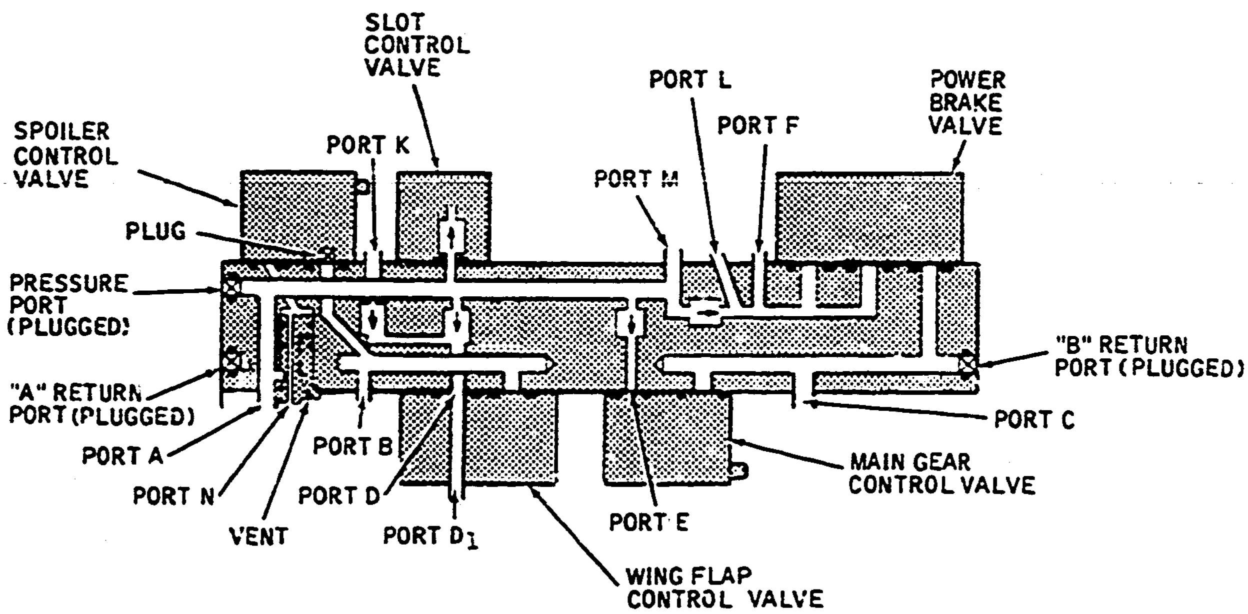
Left Hydraulic Power Manifold -- Schematic
Figure 19



RIGHT MAIN GEAR
WHEEL WELL



NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



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Right Hydraulic Power Manifold -- Schematic
Figure 20

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hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve down-line return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

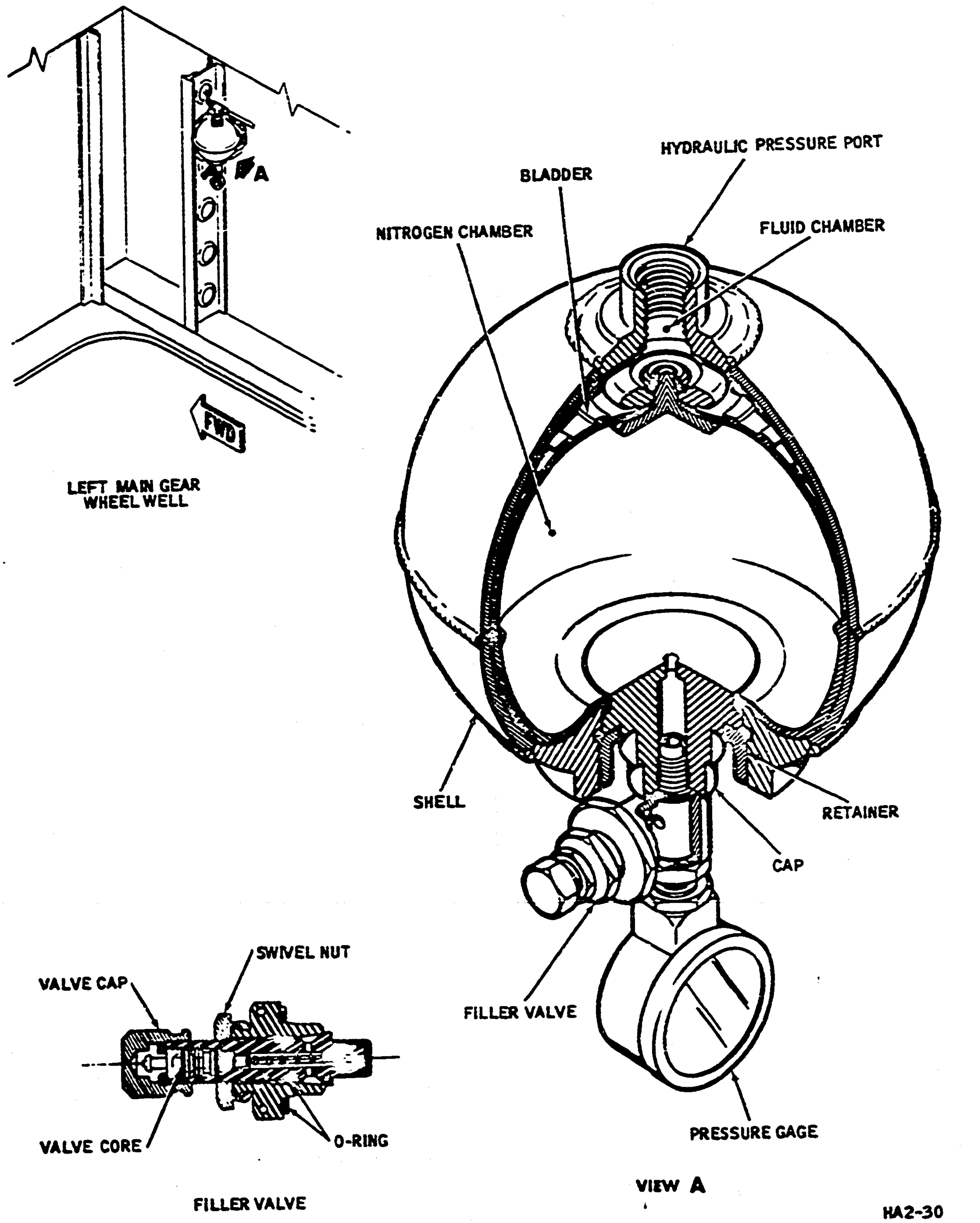
R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 21.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smoothes out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.



Hydraulic Power System Accumulator --
Cutaway View
Figure 21

T. Hydraulic System Priority Valve (See Figure 22.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

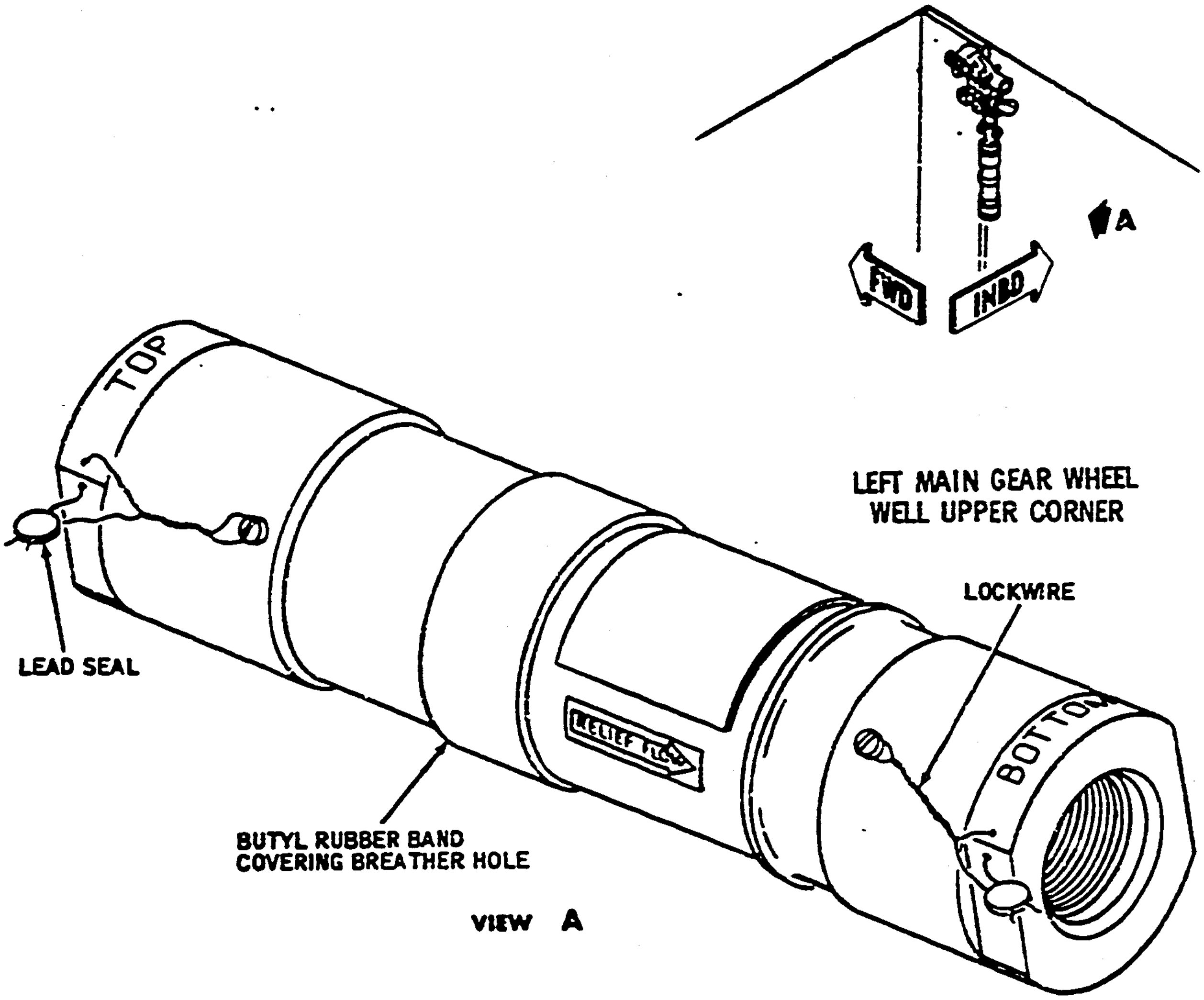
(c) Wing flaps down -- 8 gpm (10 seconds)

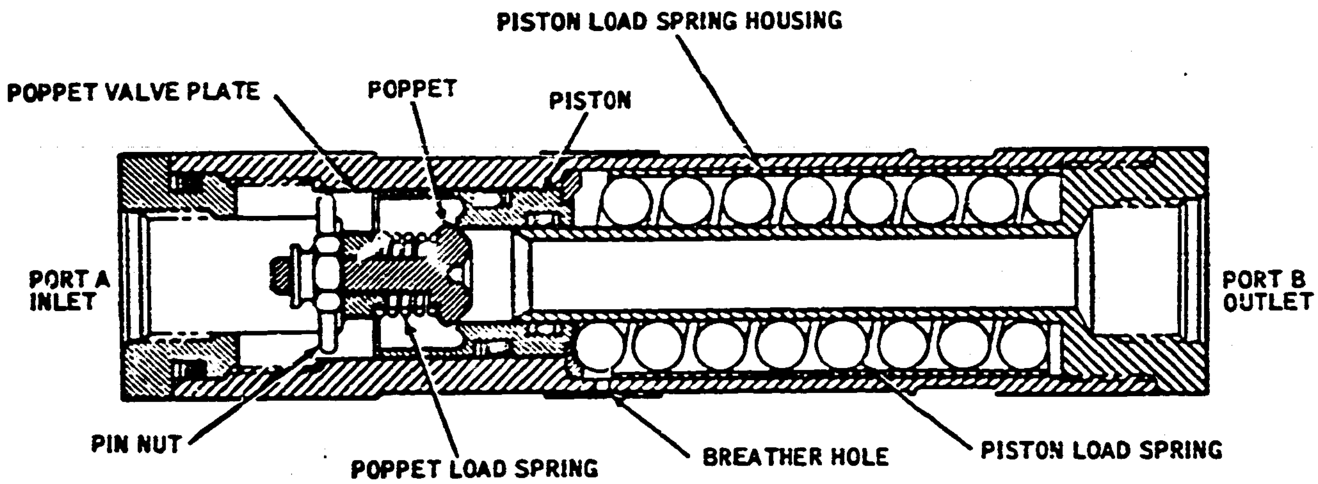
(d) Wing giaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)





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Hydraulic System Priority Valve -- Cutaway View
Figure 22

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Manual Shutoff Valve (See Figure 23.)

(1) Two manually operated shutoff valves are provided just downstream of the priority valve for isolation of non-priority subsystems during maintenance operations. One valve shuts off pressure to the following subsystems:

(a) Wing flaps

(b) Wing slots

(c) Main landing gear retraction

(d) Power wheel brakes

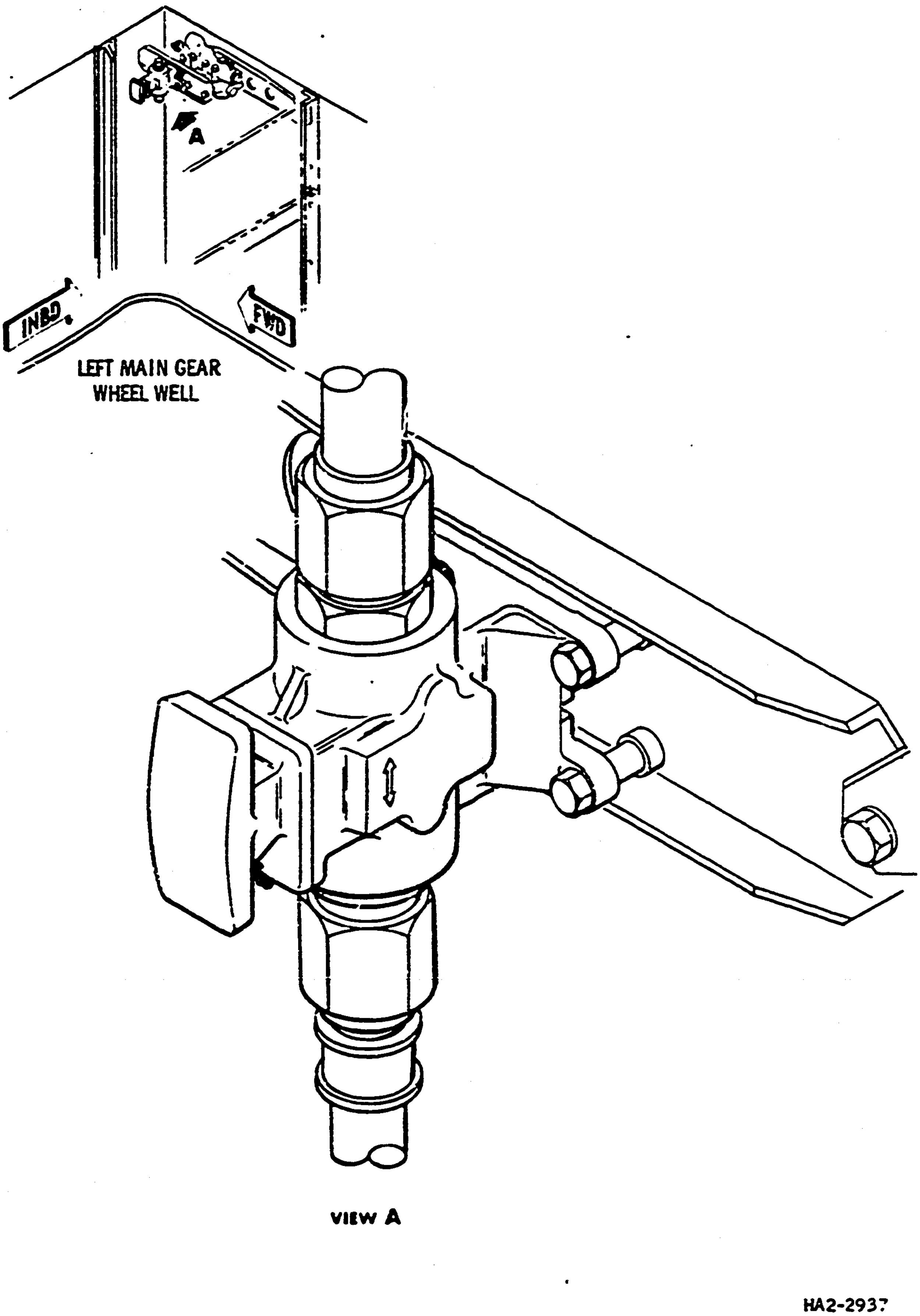
(2) The other valve shuts off pressure to the nosegear retraction and nosewheel steering subsystems.

(3) The manual shutoff valves are located in the upper inboard forward corner of the left main gear wheel well. One valve is mounted on the left power manifold support, the other is mounted to a structure stiffener.

(4) The valves consist of two position (on-off), rotary type, valves with identical and interchangeable inlet and outlet ports. A T shaped handle is provided on each valve for manual operation and lockwire holes are provided in the base of the handle for safetying the valve in the open position.

V. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.



Manual Shutoff Valve
Figure 23

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid; and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure fr the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

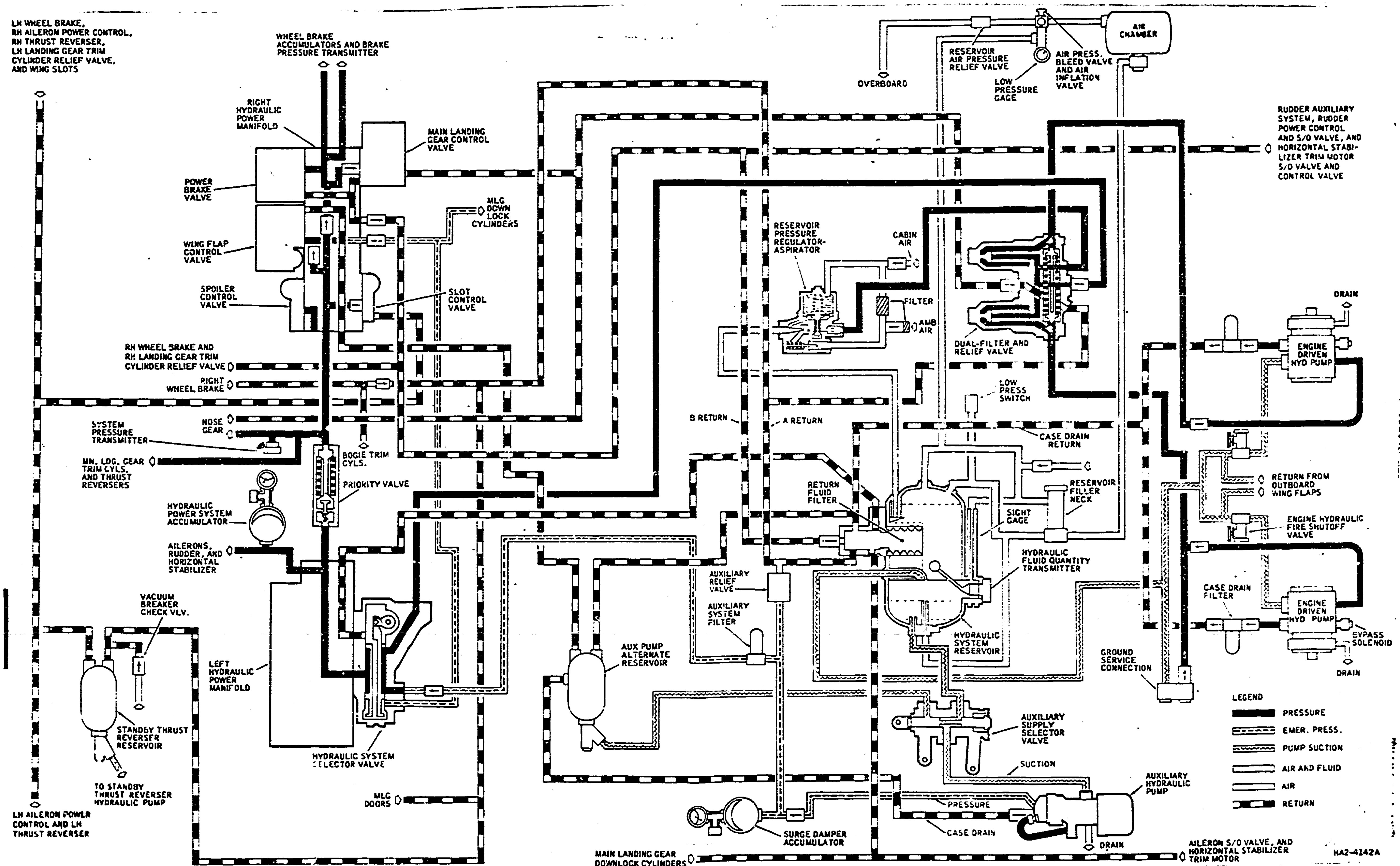
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

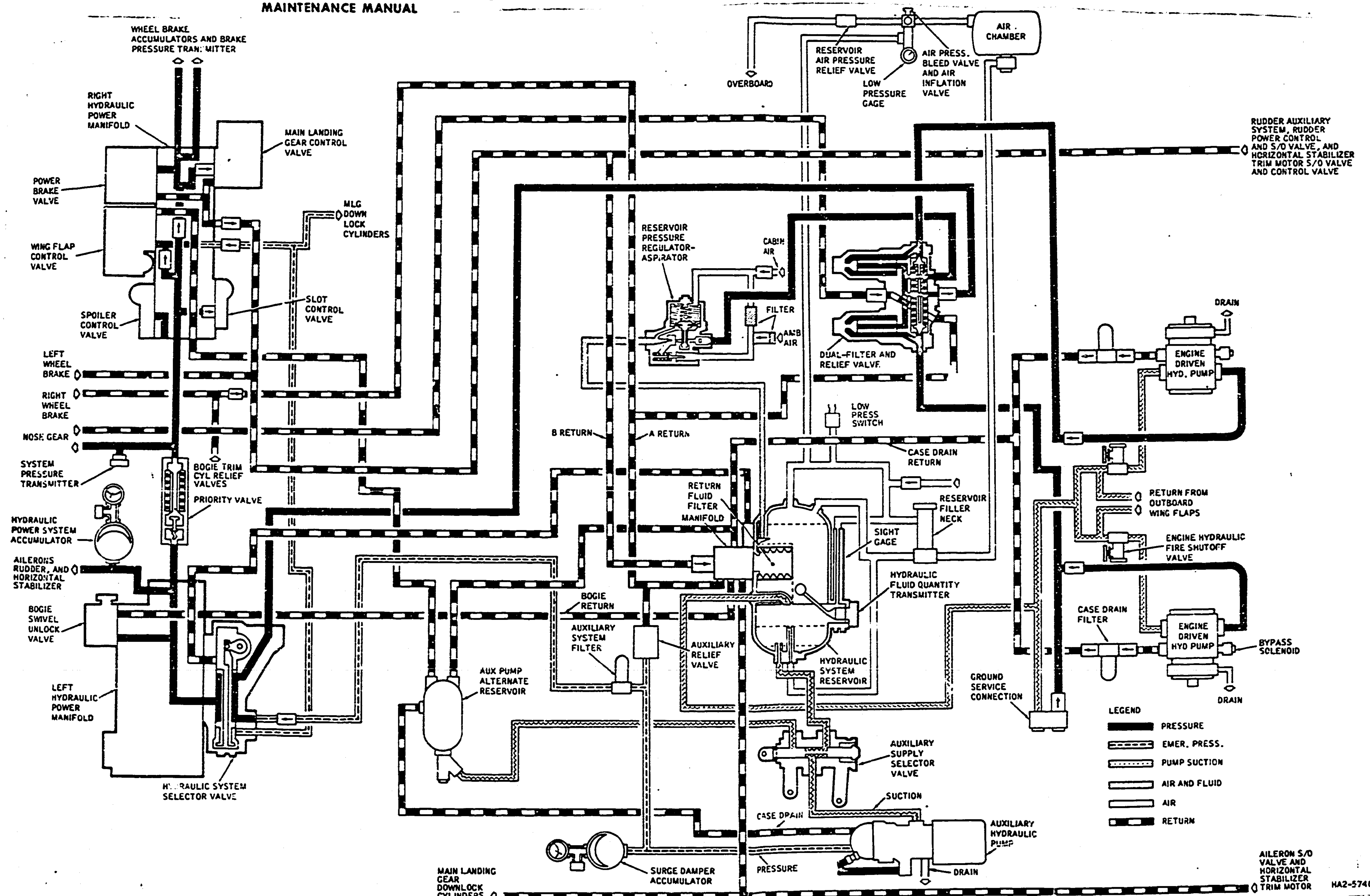
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

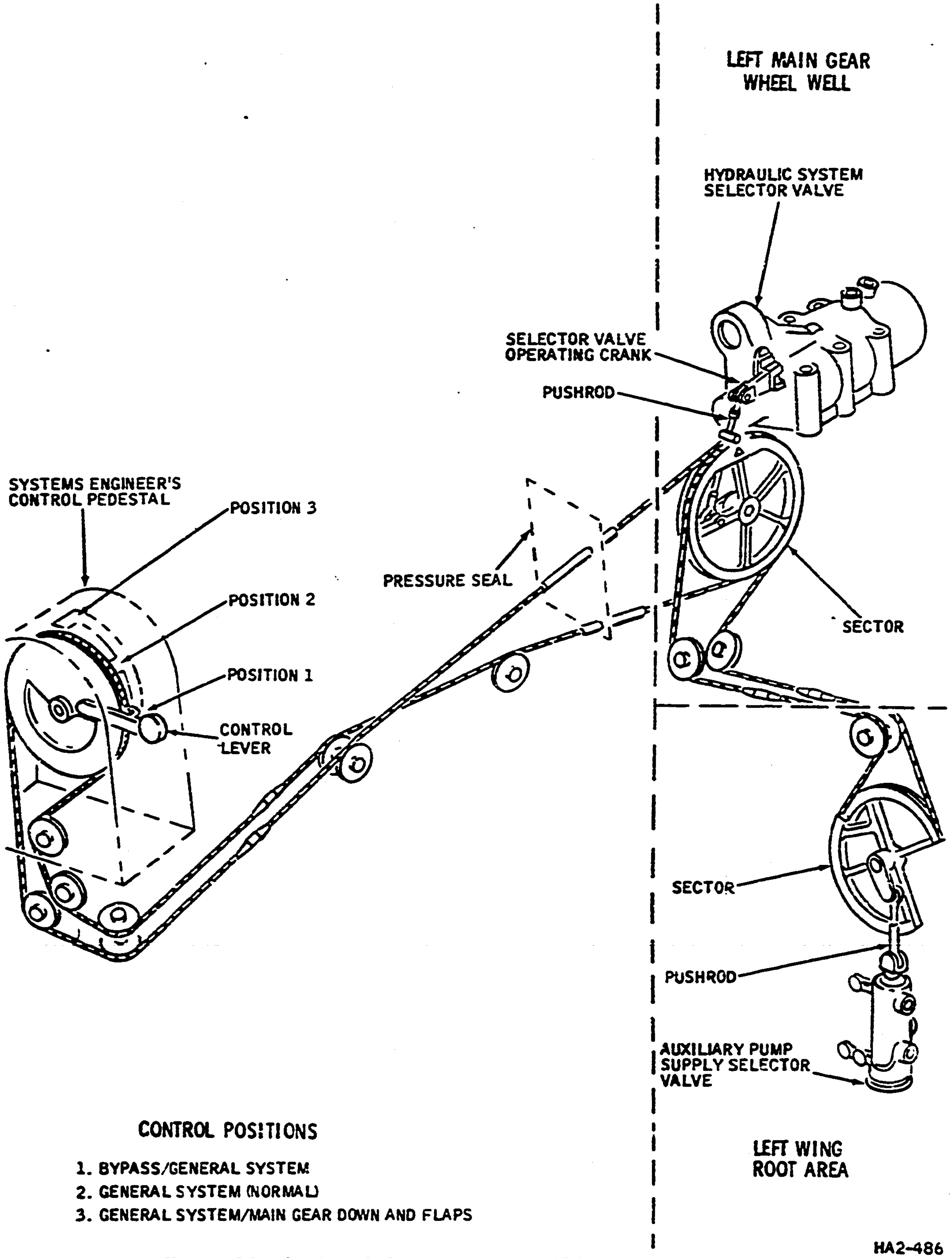
(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram (Airplanes JA8031 - JA8037, JA8040, JA8044, JA8051 and Subsequent)
Figure 1 (Sheet 1)



Hydraulic Power System -- Schematic Diagram (Airplanes JA8038, JA8039, JA8041-JA8043, JA8045-JA8048)
Figure 1 (Sheet 2)



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

back to the reservoir via A return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold, the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure, and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve. A line, teed into the alternate supply line, runs directly to a shuttle valve in the main gear downlock cylinder line. When auxiliary pressure is applied, the shuttle valve shifts, porting fluid into the downlock bungee cylinder's downlock side.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

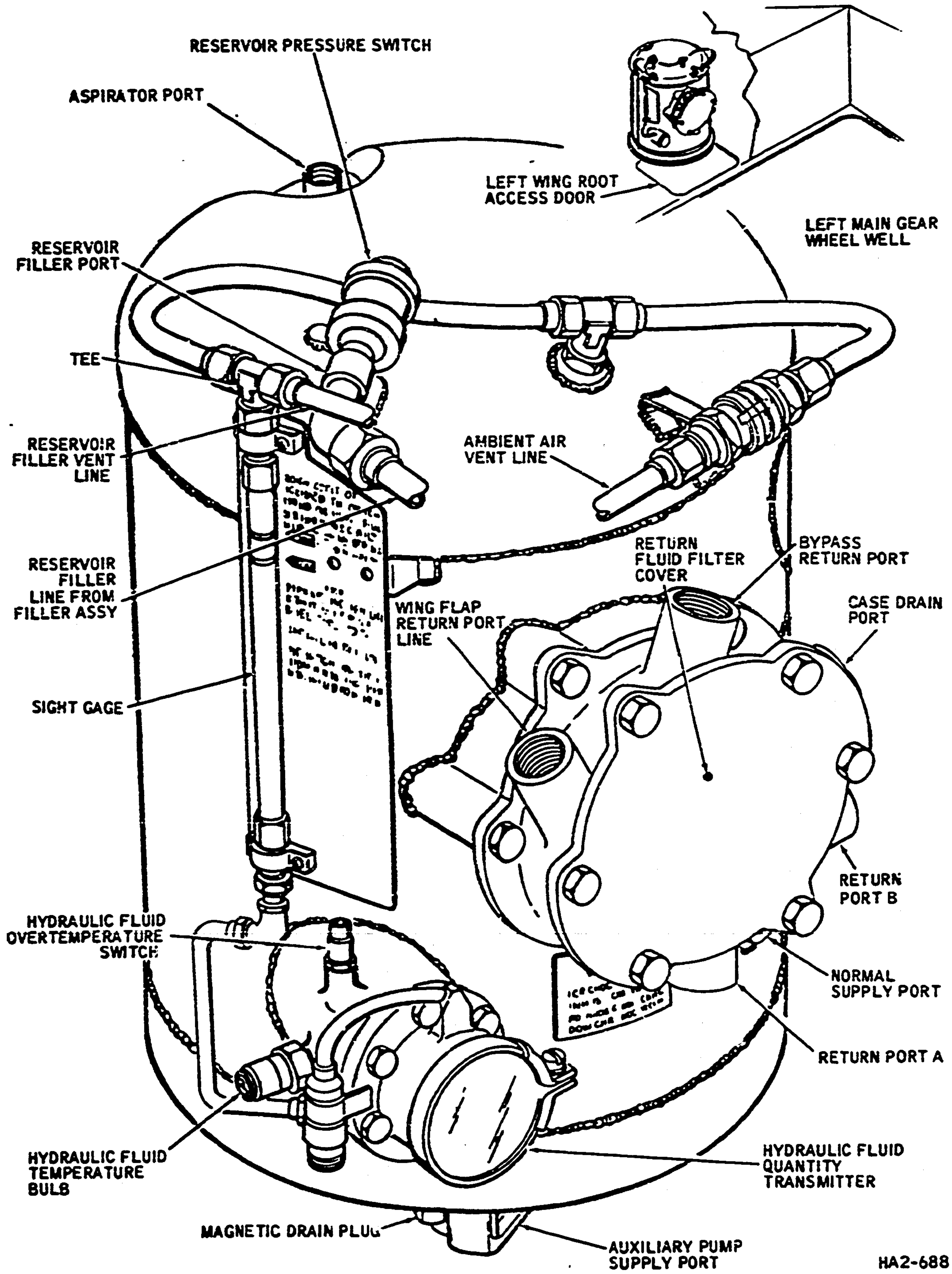
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

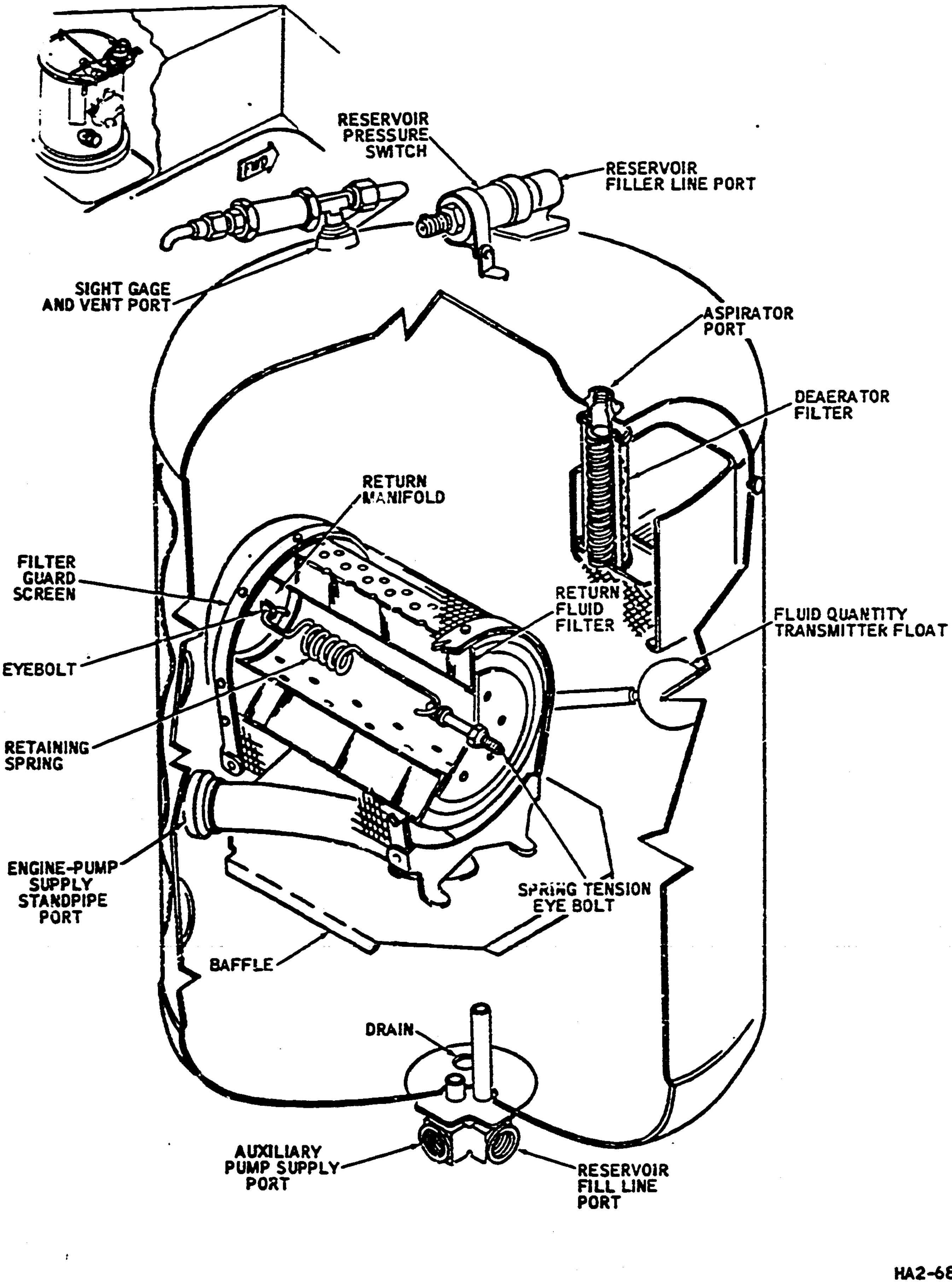
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing rear spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port,



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold

by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

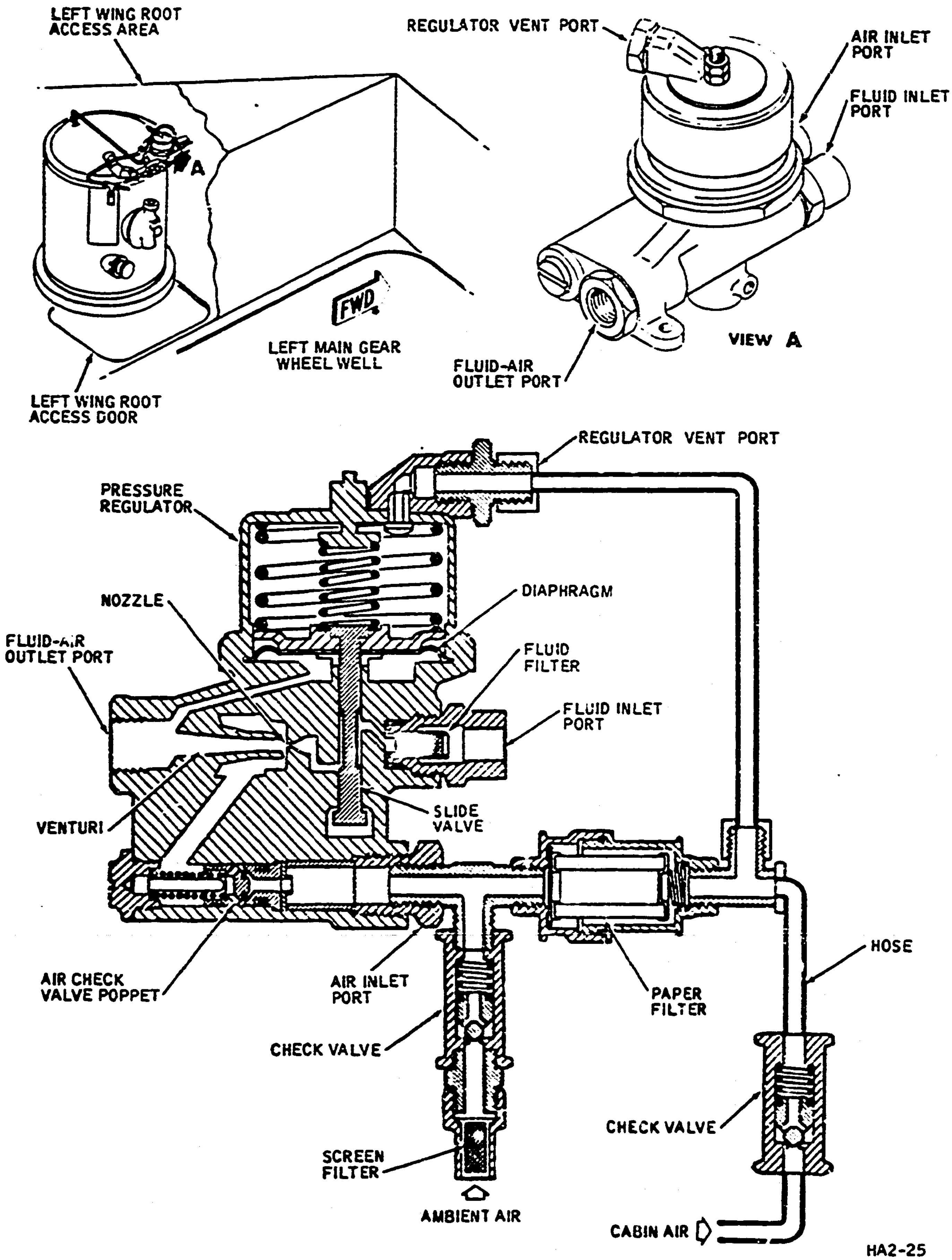
(3) Internally, the filter has a 3-micron, resin-impregnated, convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure foreign matter, the filter acts as its own relief valve which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. Th plug for an air check valve is located near the outlet plug. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle



Reservoir Air Pressure Regulat--Aspirator -- Schematic
Figure 5

sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

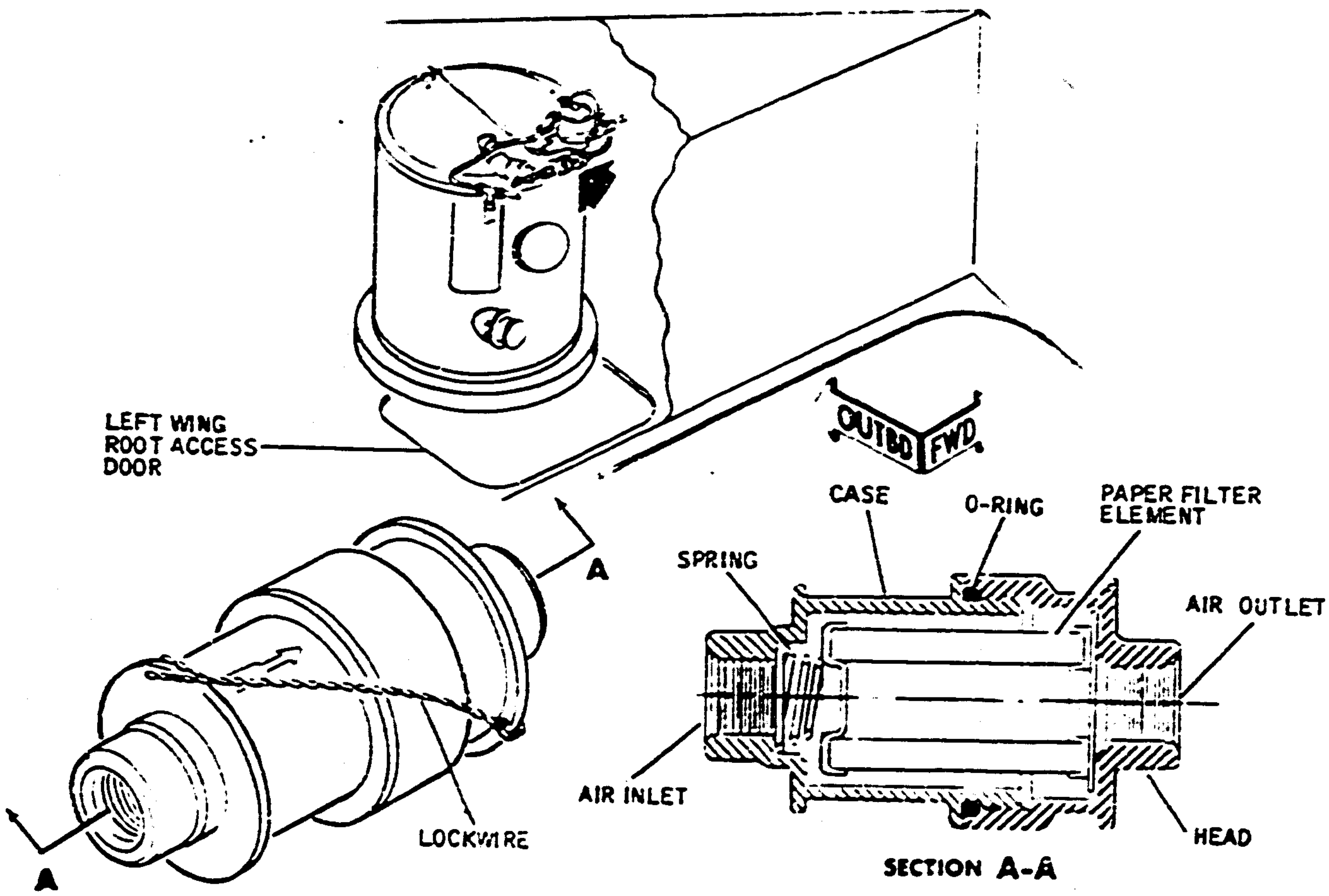
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

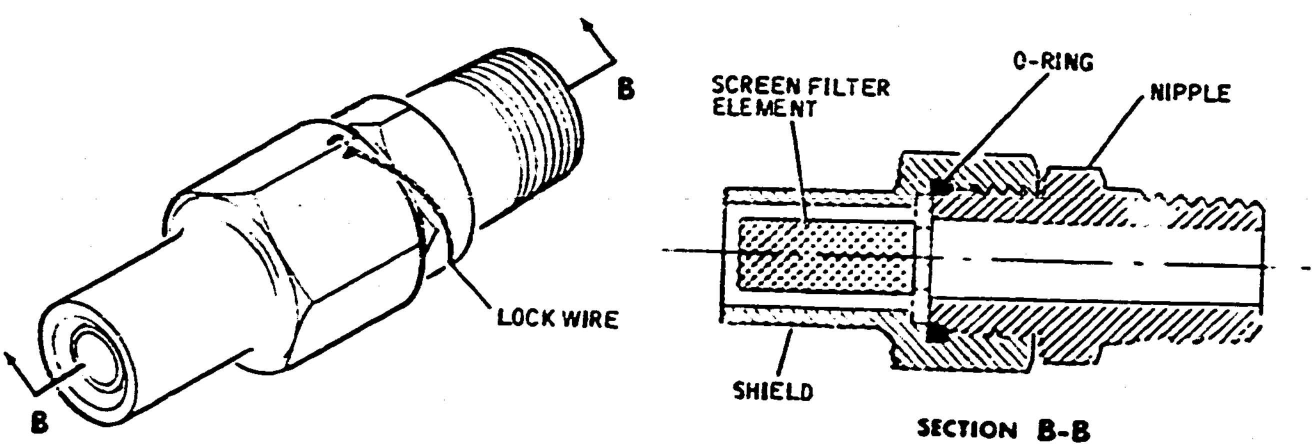
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port



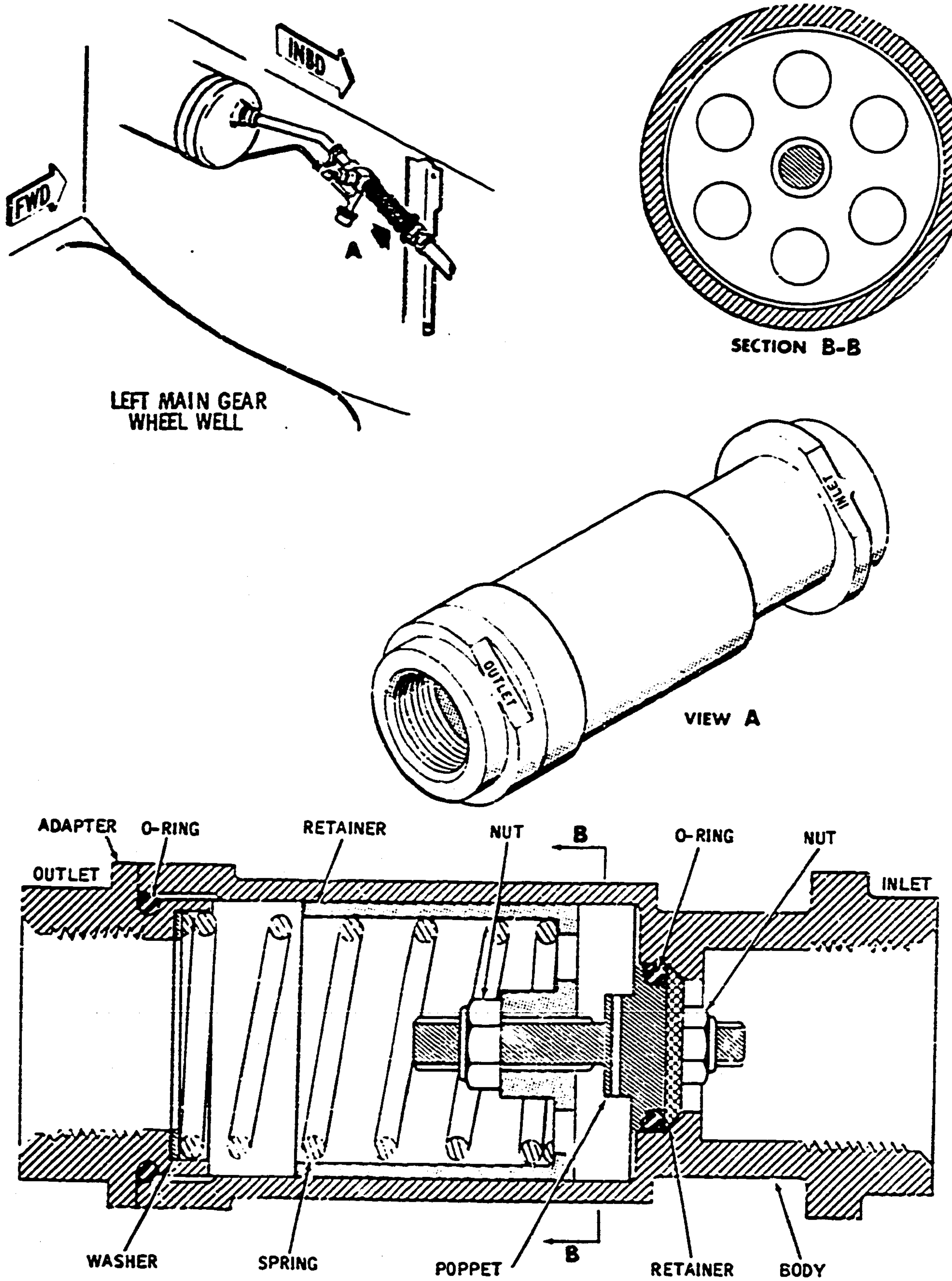
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



HA2-17

Hydraulic Reservoir Relief Valve
Figure 7

and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

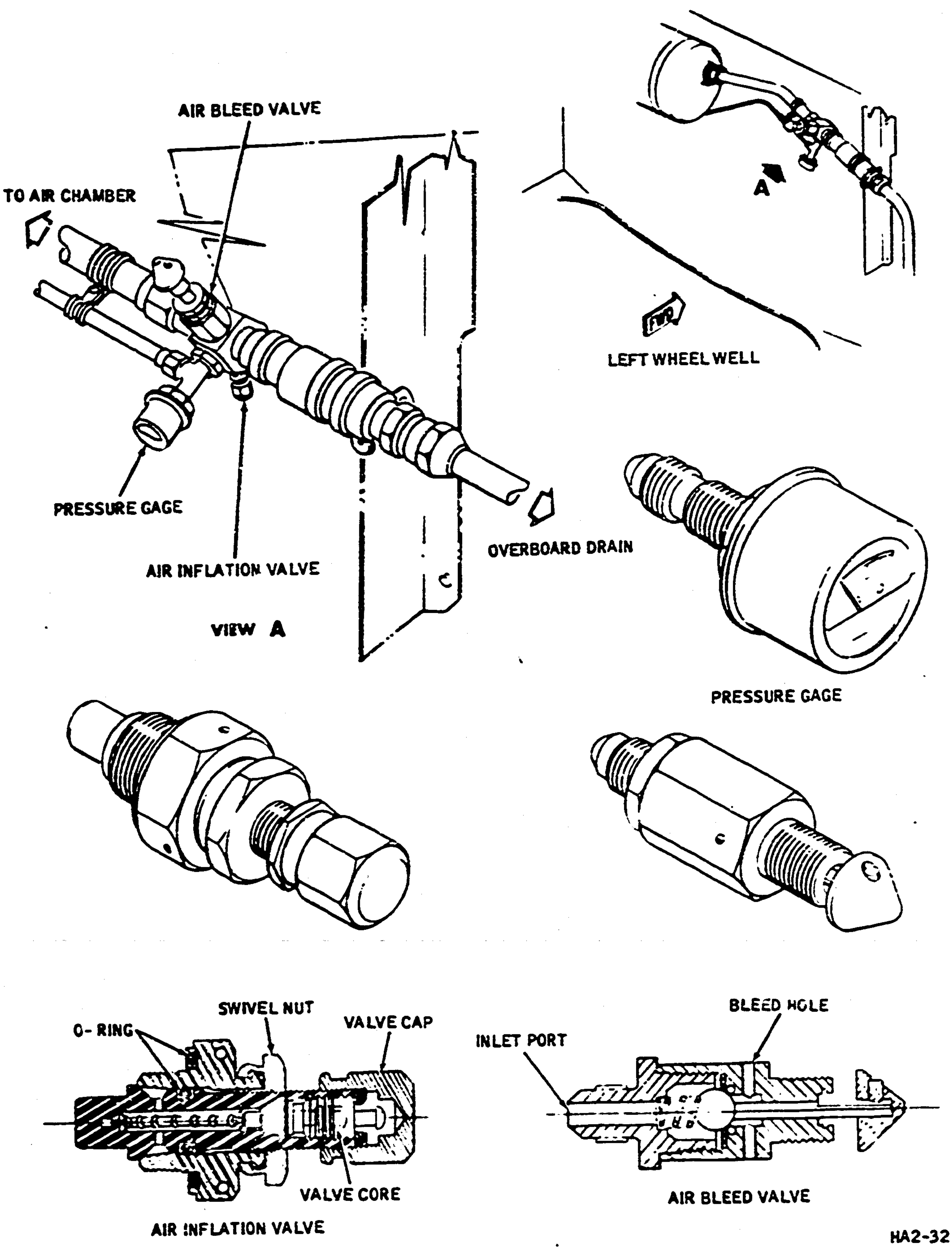
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

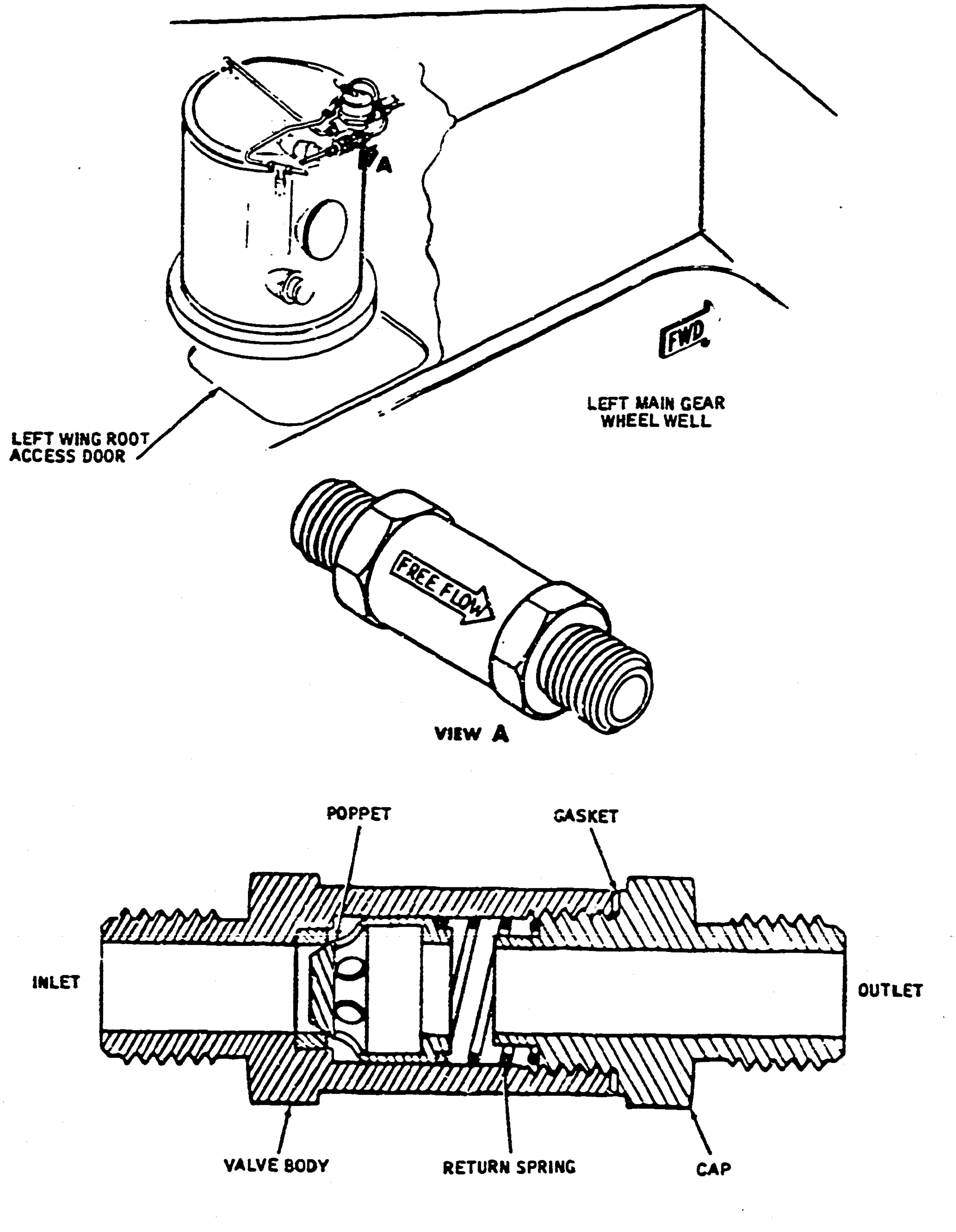
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a



Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage
Figure 8



Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

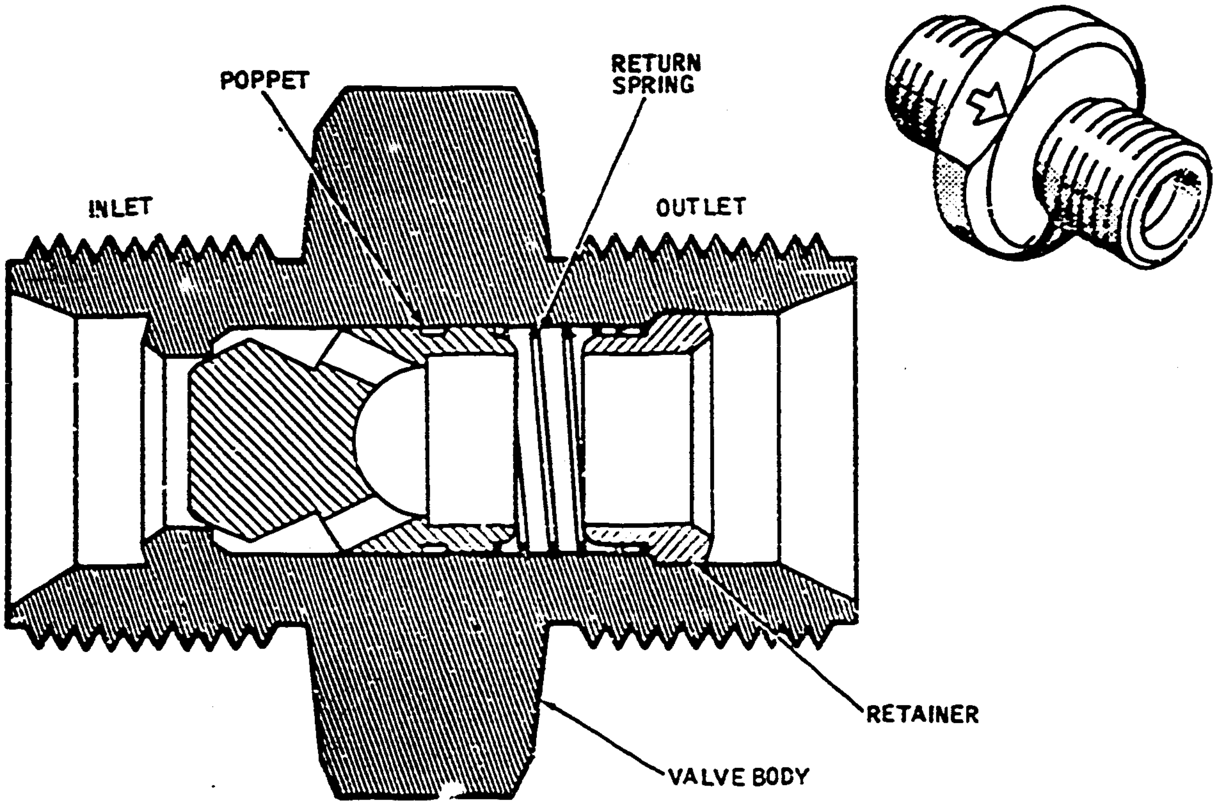
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

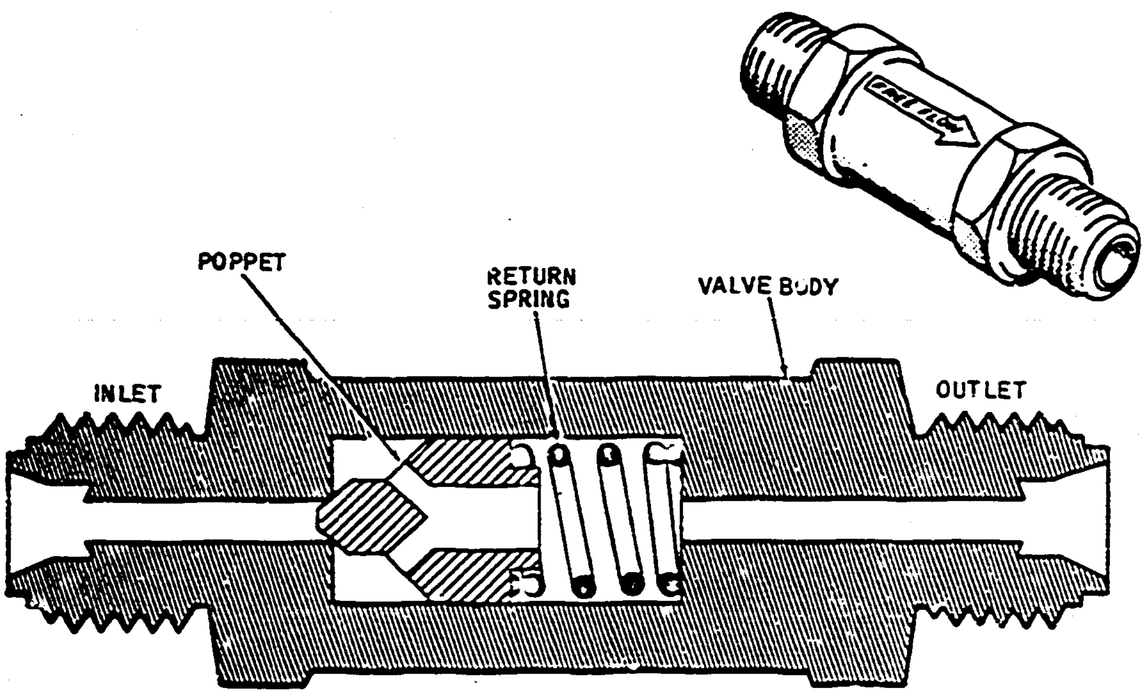
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10

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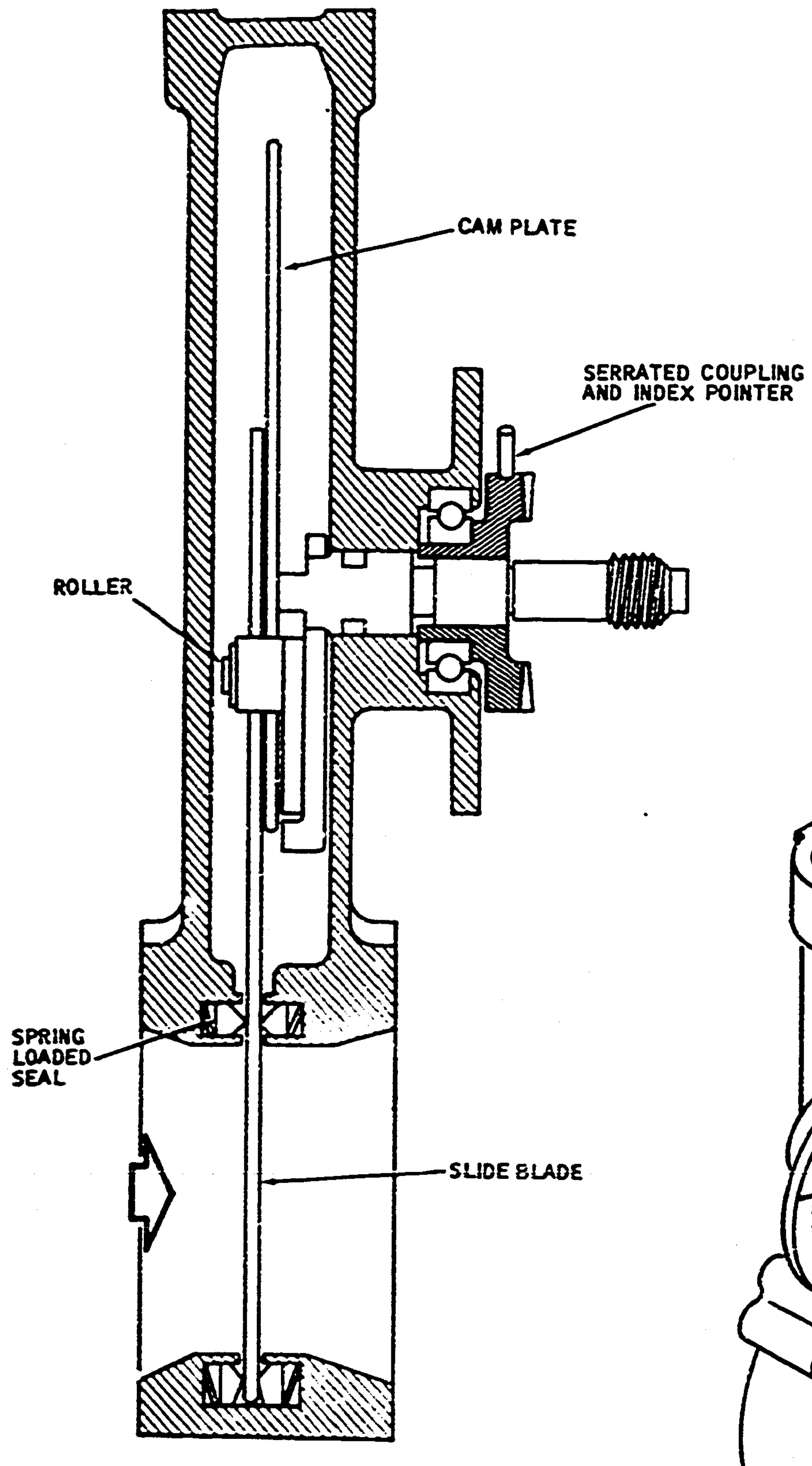

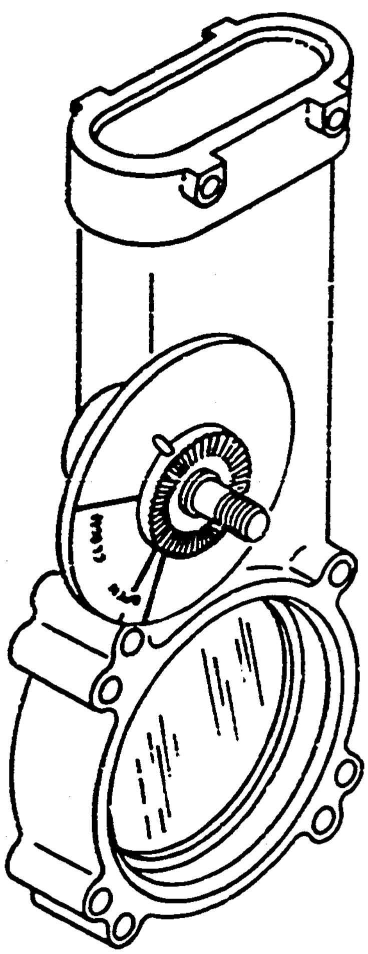

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Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11

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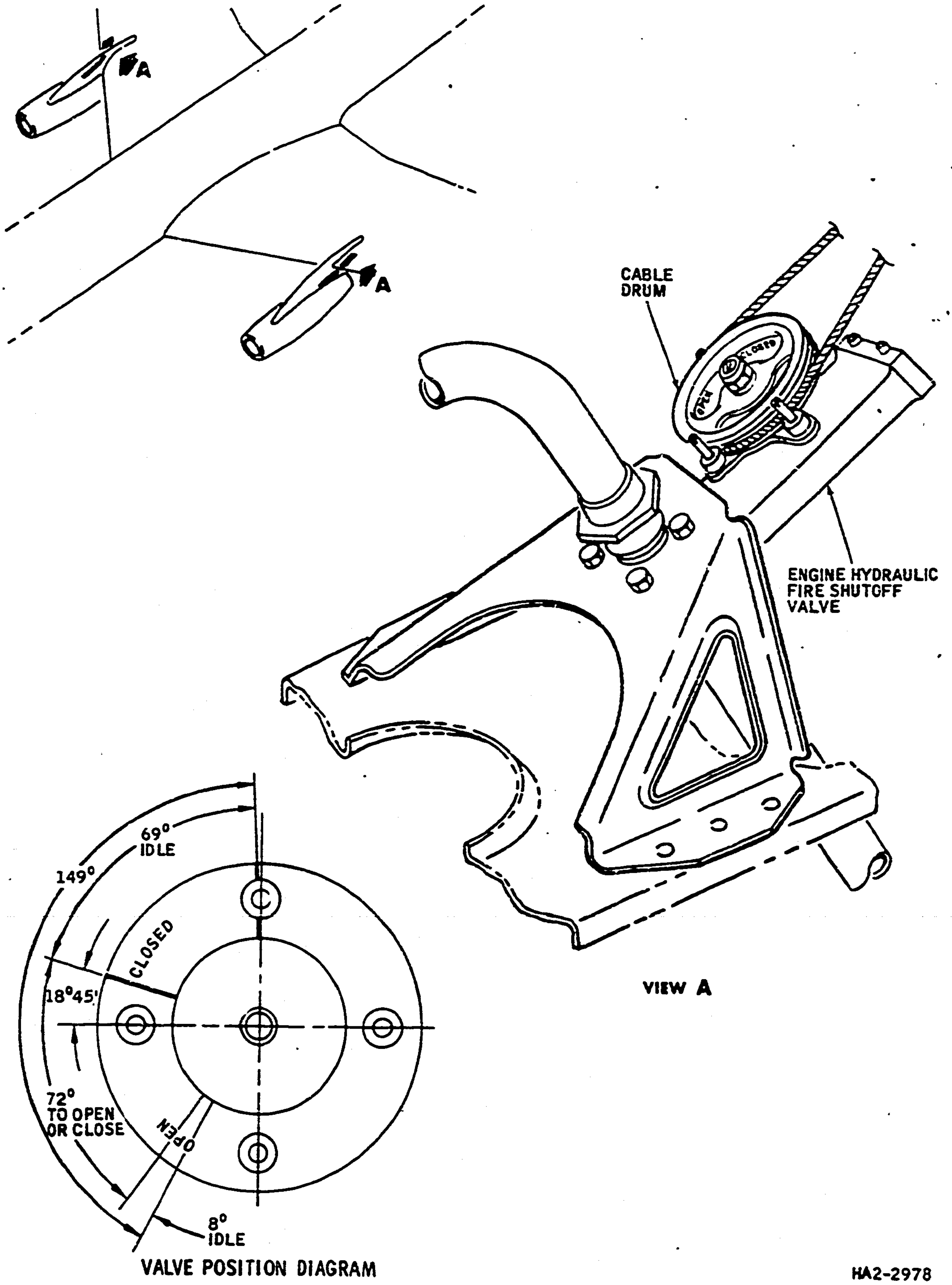
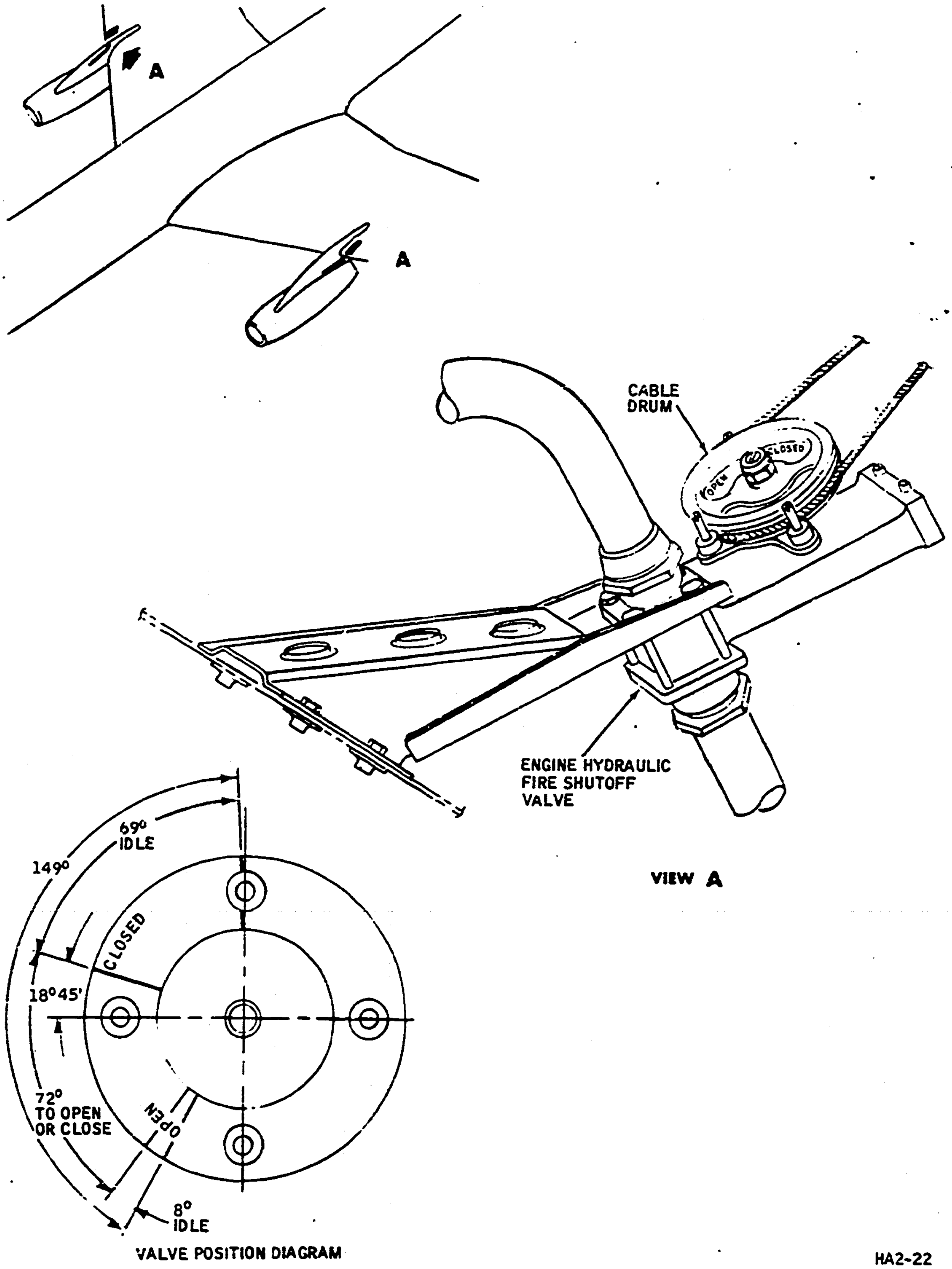


Engine Hydraulic Fire Shutoff Valve
(Airplanes JA8031-JA8037, JA8040, JA8044,
JA8051 and Subsequent)
Figure 12 (Sheet 1)



Engine Hydraulic Fire Shutoff Valve
(Airplanes JA8038, JA8039, JA8041-JA8043, JA8045-JA8048)
Figure 12 (Sheet 2)

through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

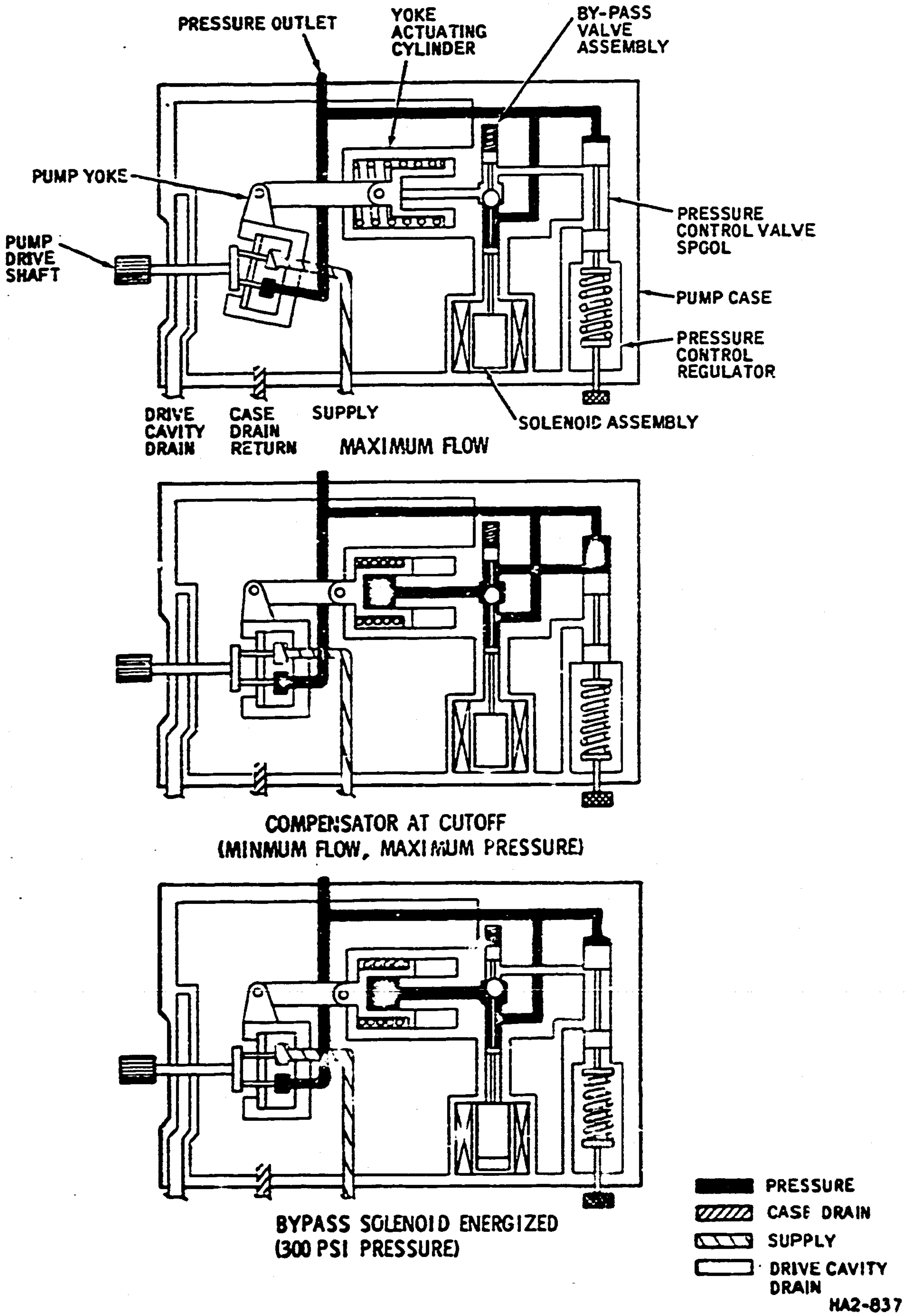
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulator meters the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump stabilizes in accordance with system demand.

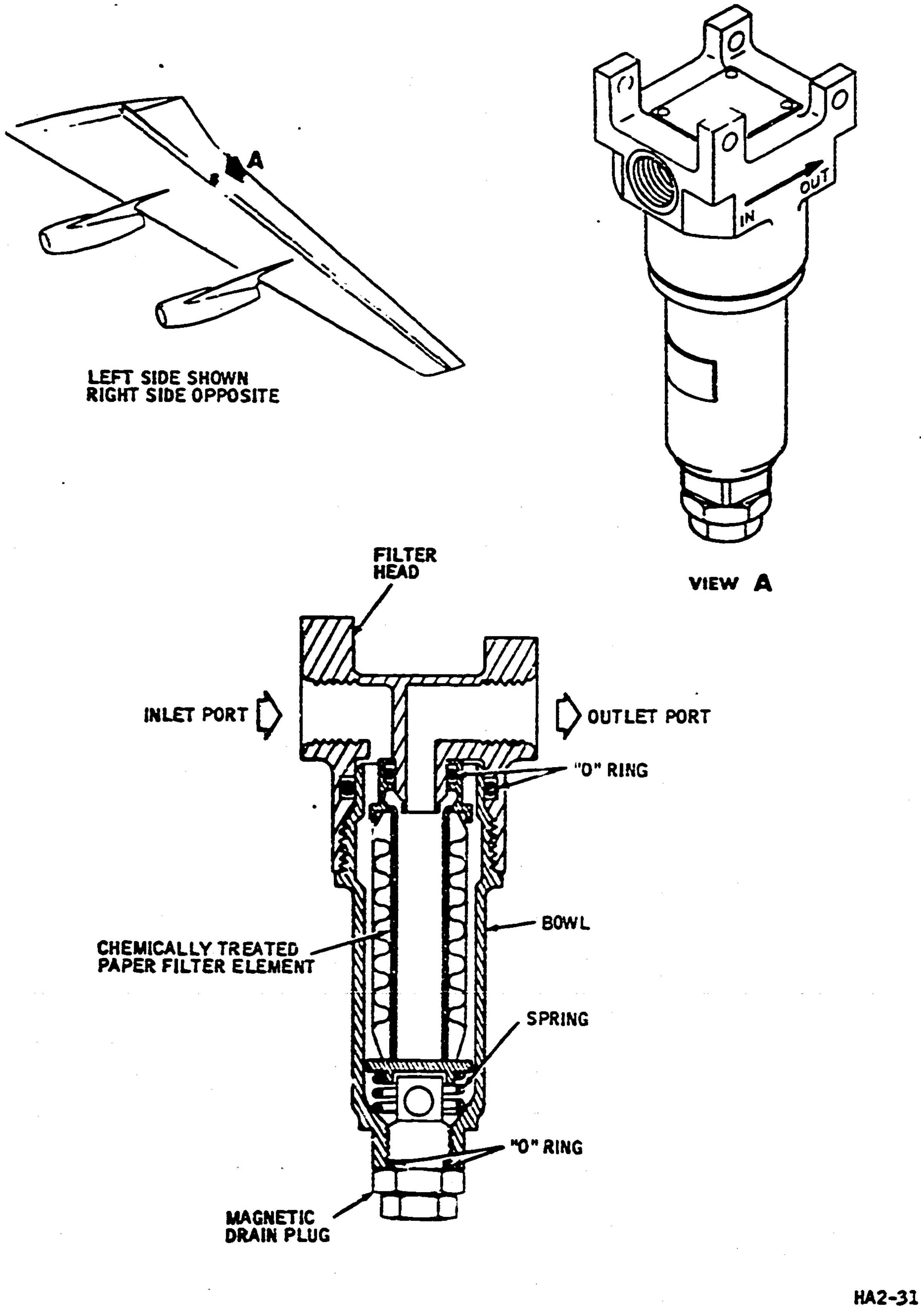
L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain return line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the



Engine-Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

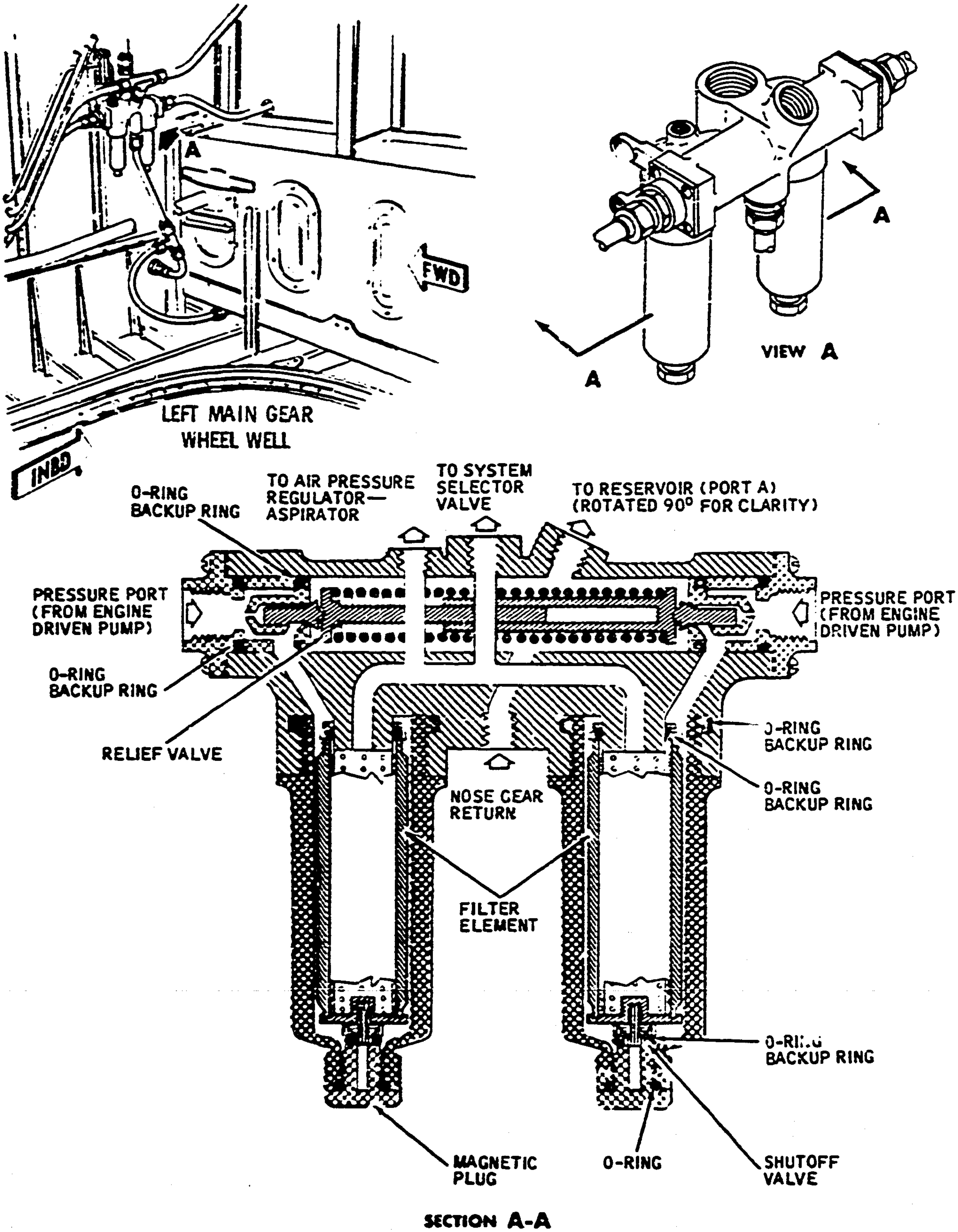
(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3300 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow of pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.



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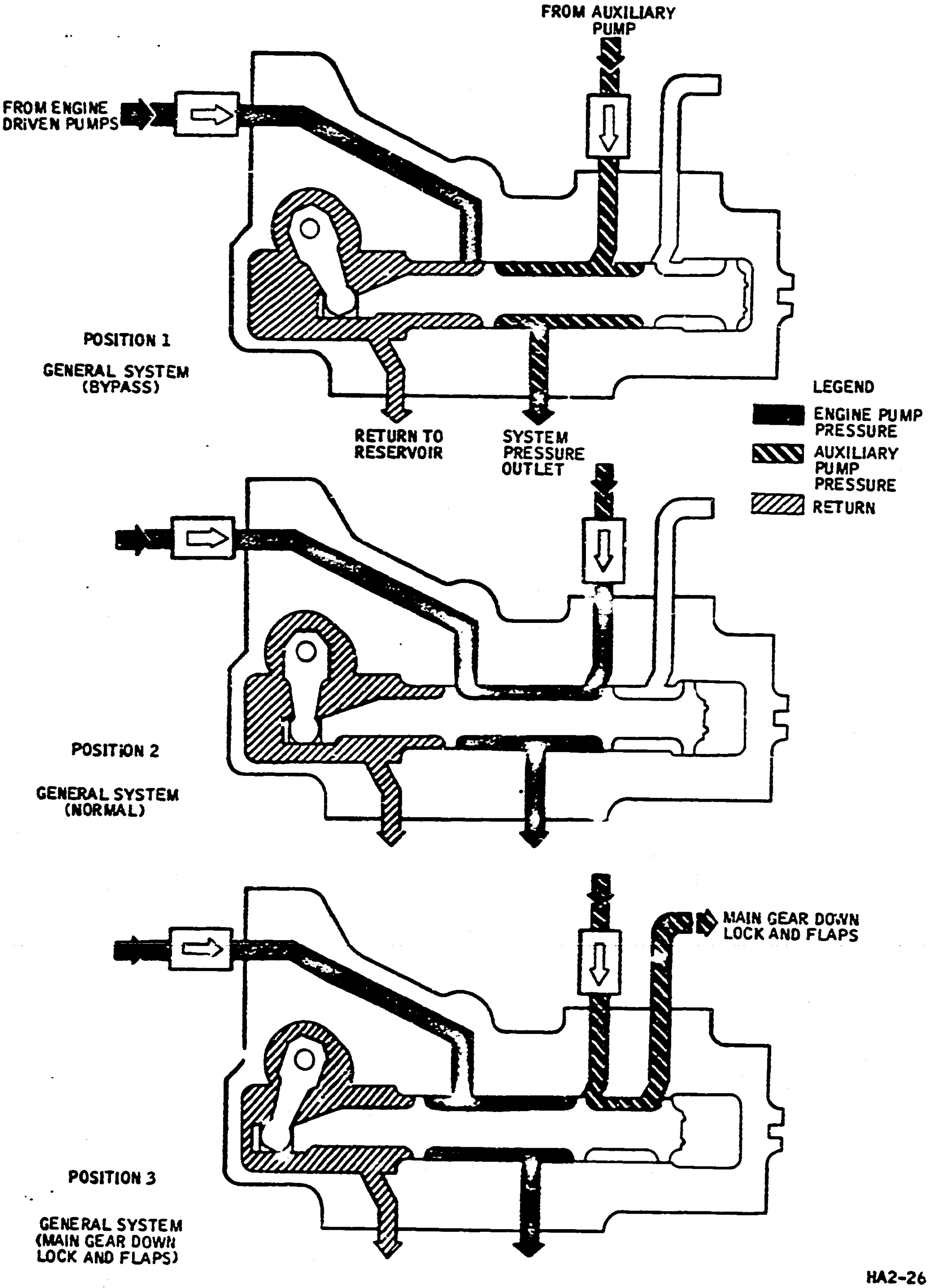
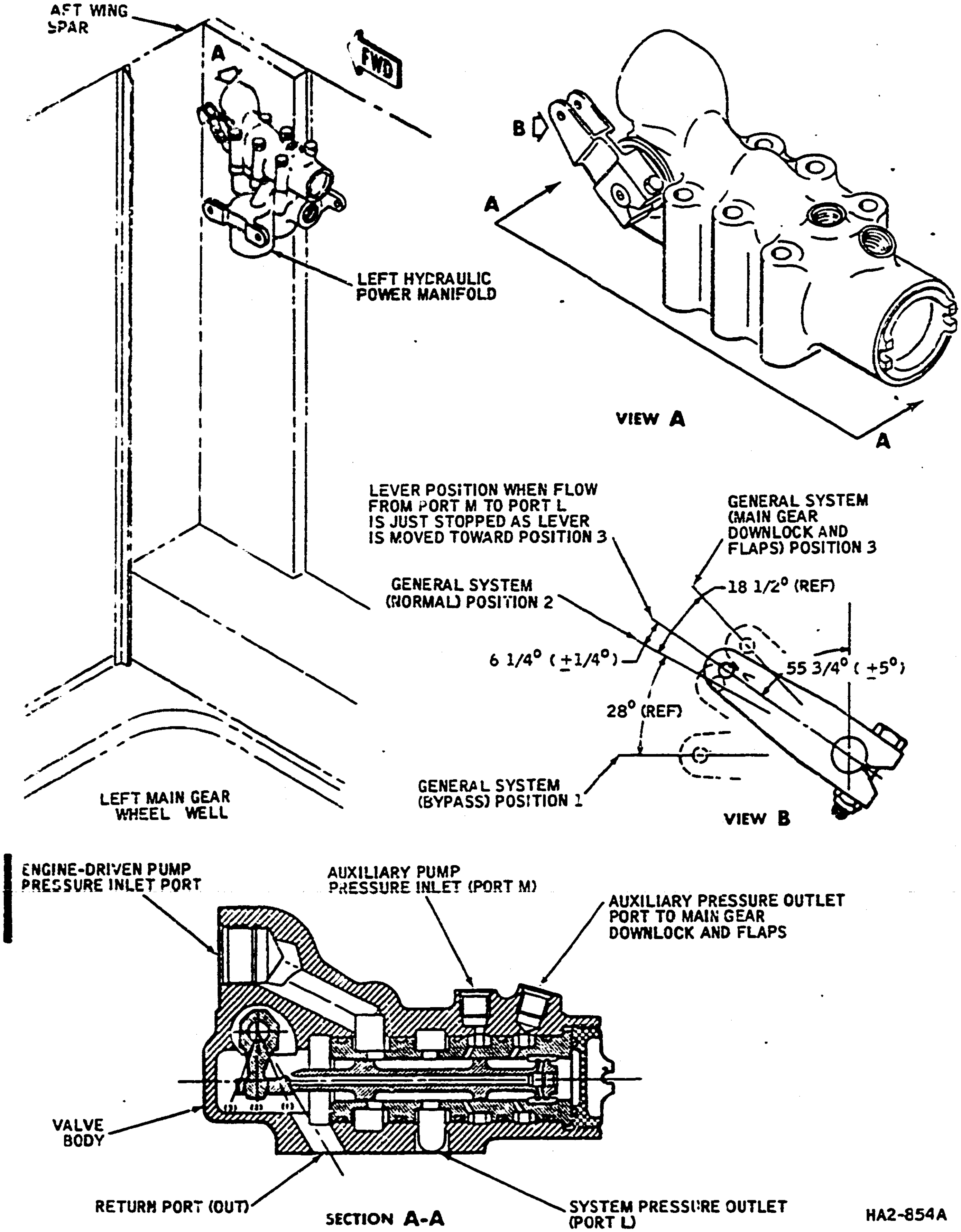
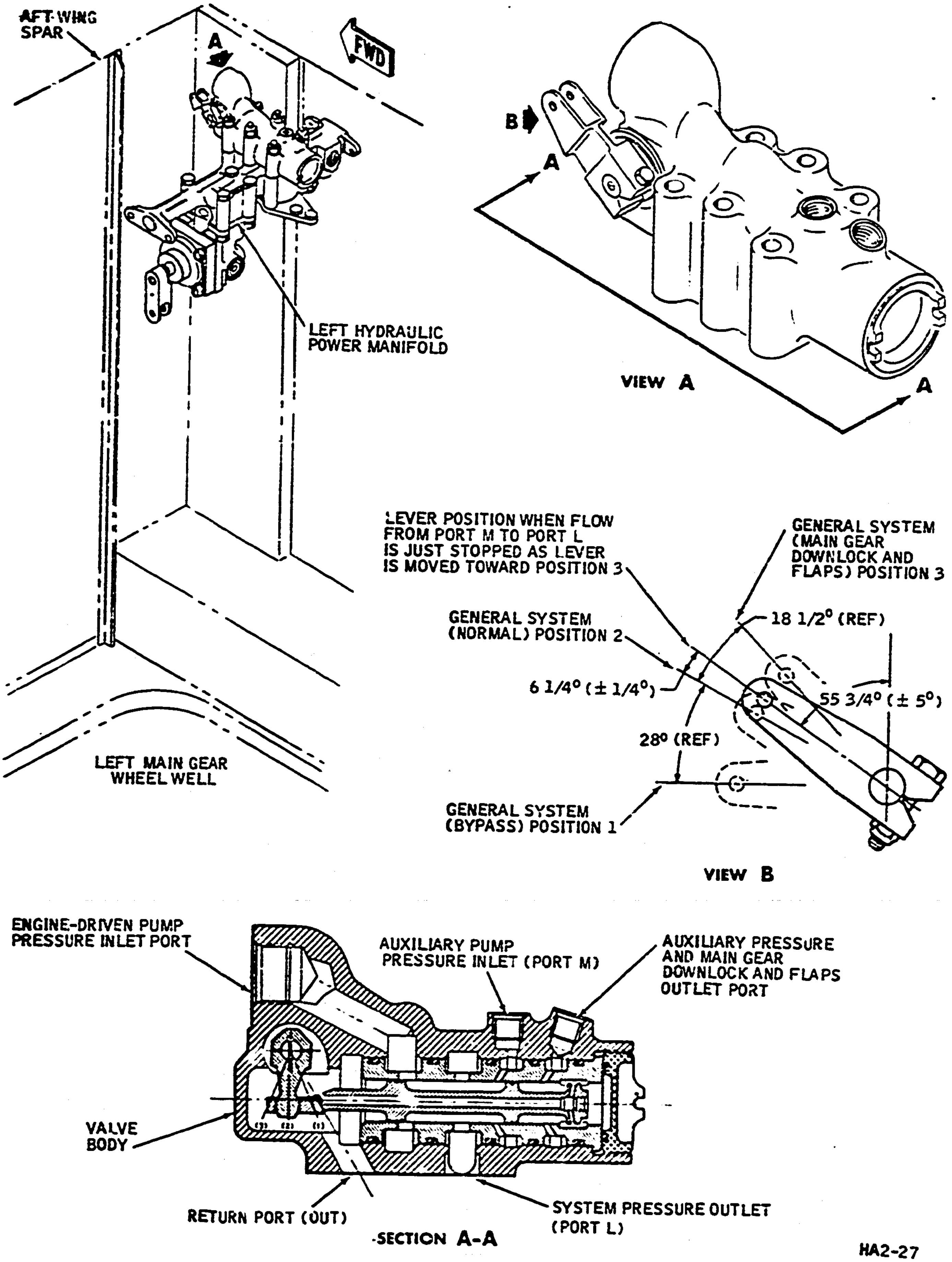
Dual-Filter and Relief Valve -- Cutaway View
Figure 15



System Selector Valve -- Schematic
Figure 16



System Selector Valve — Cutaway View
(Airplanes JA8031-JA8037, JA8040, JA8044,
JA8051 and Subsequent)
Figure 17 (Sheet 1)



System Selector Valve — Cutaway View
(Airplanes JA8038, JA8039, JA8041–JA8043, JA8045–JA8048)
Figure 17 (Sheet 2)

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear down and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps and the landing gear downlock cylinders. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

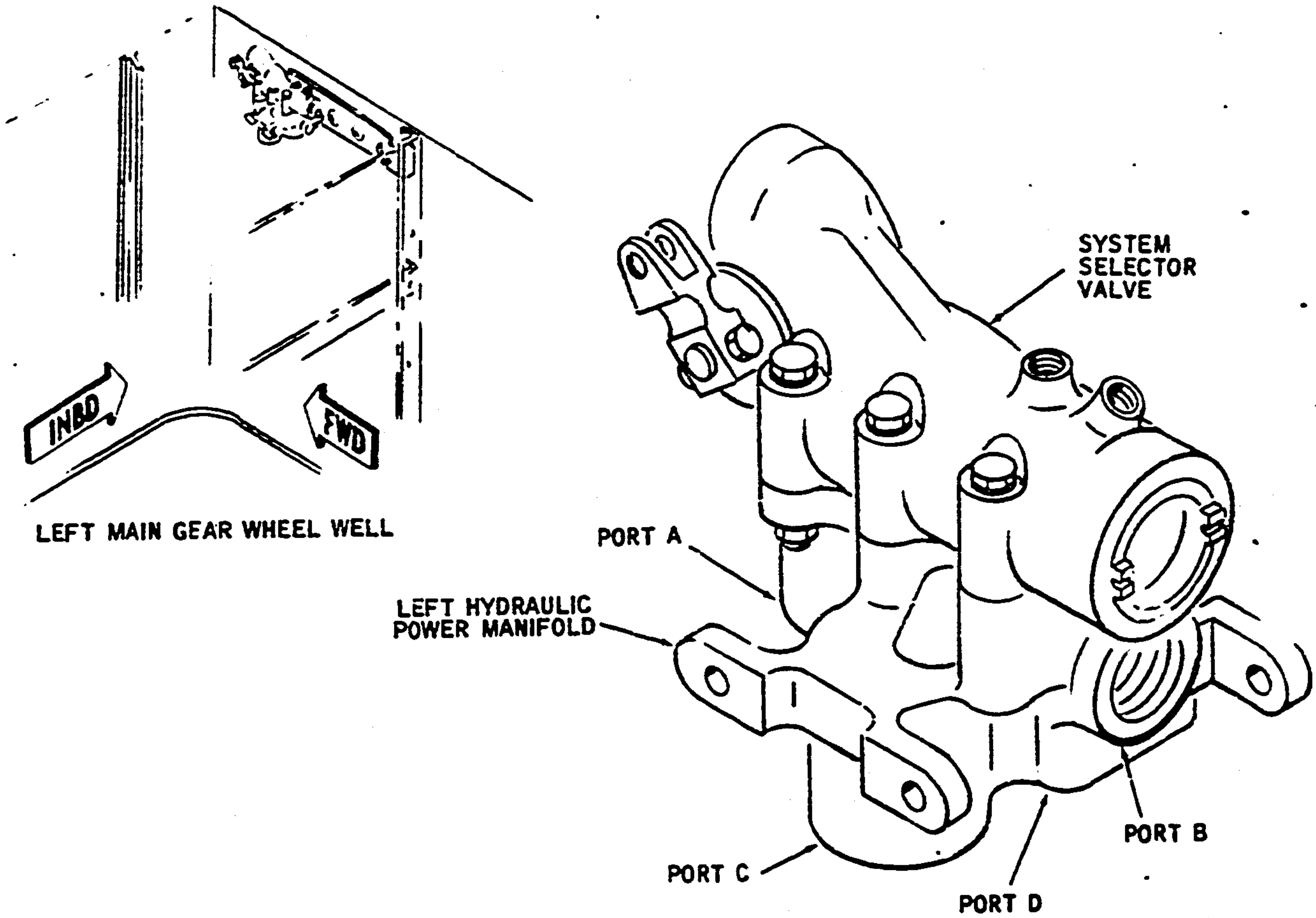
(2) On airplanes JA8031-JA8037, JA8040, JA8044, JA8051 and subsequent, one valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

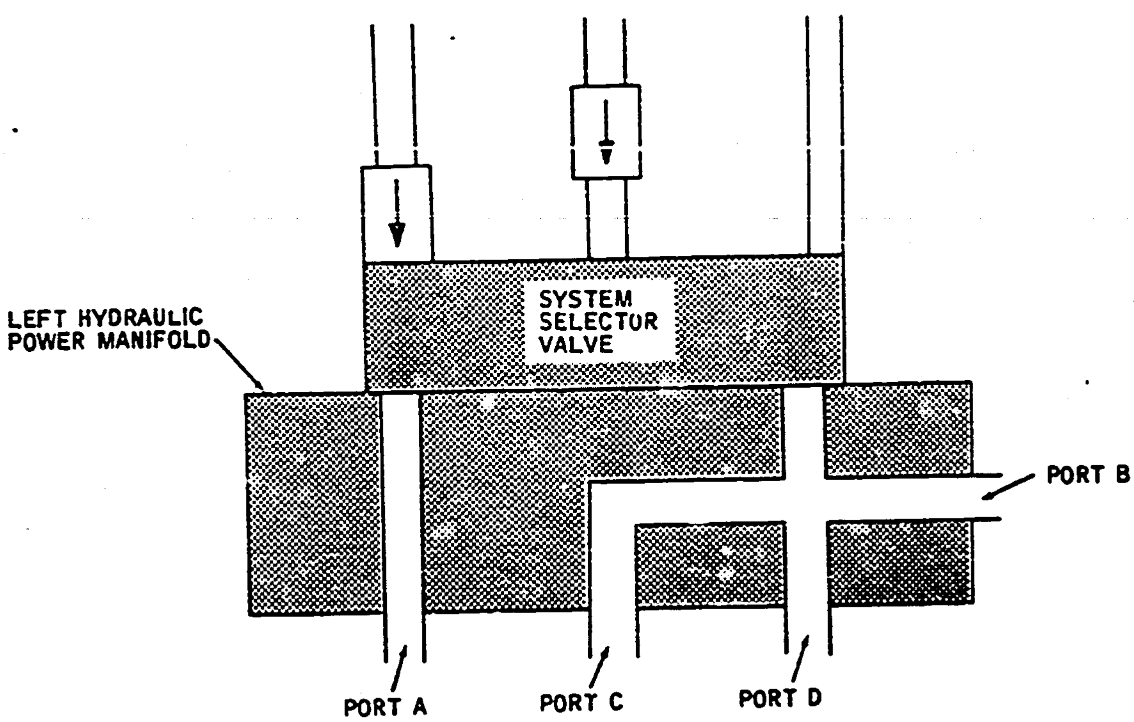
(3) On airplanes JA8038 and JA8039, JA8041-JA8043, JA8045-JA8048, three valve-mounting pads are provided on the manifold. The system selector valve-mounting pad is located on top of the manifold body. Of the two remaining mounting pads, located on the underside of the manifold, the

inboard pad is capped and not used. The outboard mounting pad is used for the bogie swivel unlock control valve. Four ports are provided on the inboard end of the manifold. Two of these ports are pressure outlet ports: one, located on the aft face of the manifold, is for the flight controls; and, the other, located on the underside of the manifold, ports fluid to the priority valve, which, in turn, ports fluid to the nose gear and the right power manifold. The other two ports are return outlets, located immediately forward of the manifold pressure outlet port. One is connected by a line to the right manifold, and the other is connected to the low-pressure return port of the reservoir. The pressure line to the nose gear control valve is teed into the manifold pressure connecting line. A reservoir return line is teed into the manifold return line. The two ports on the inboard mounting flange were used for drilling the internal passages of the power manifold and are plugged and safety wired to prevent use.

Q. Right Hydraulic Power Manifold (See Figure 19.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead.





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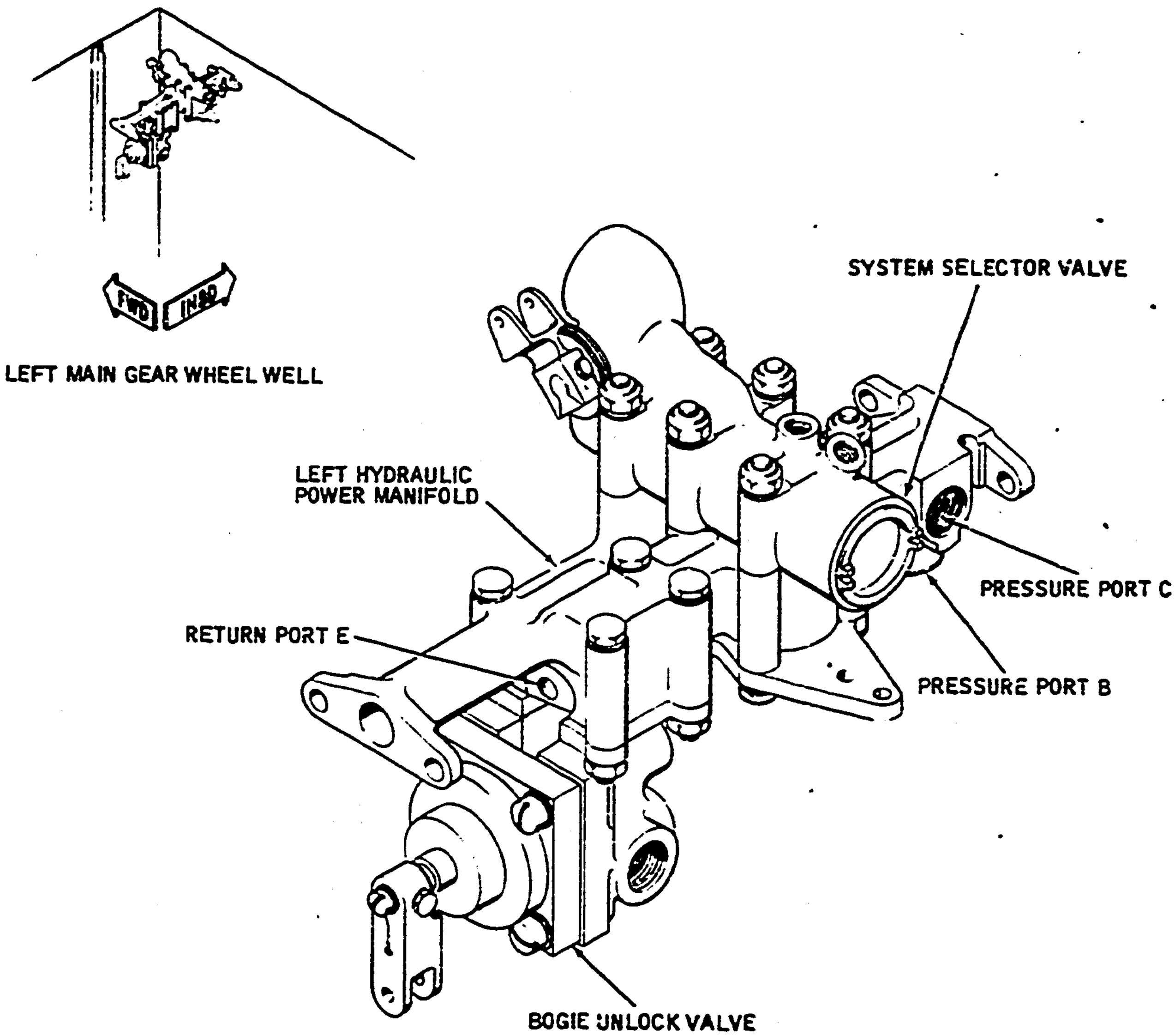
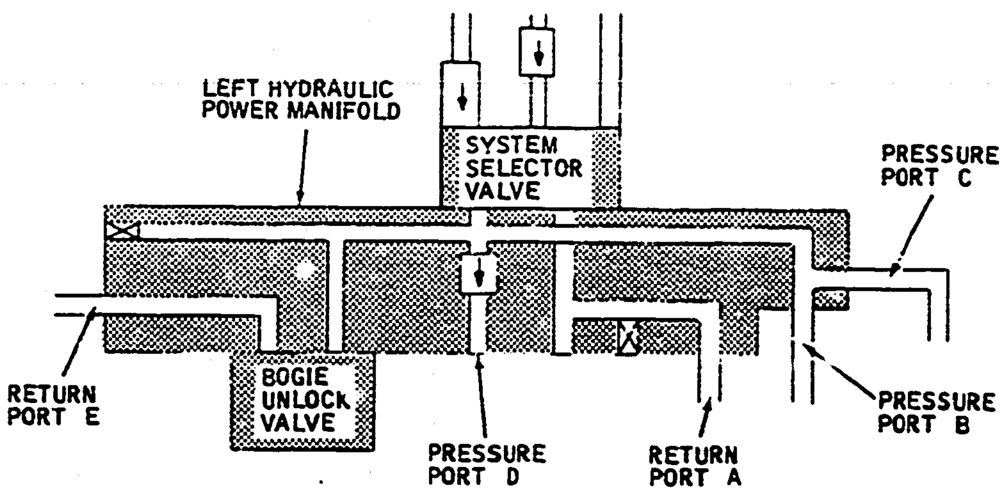
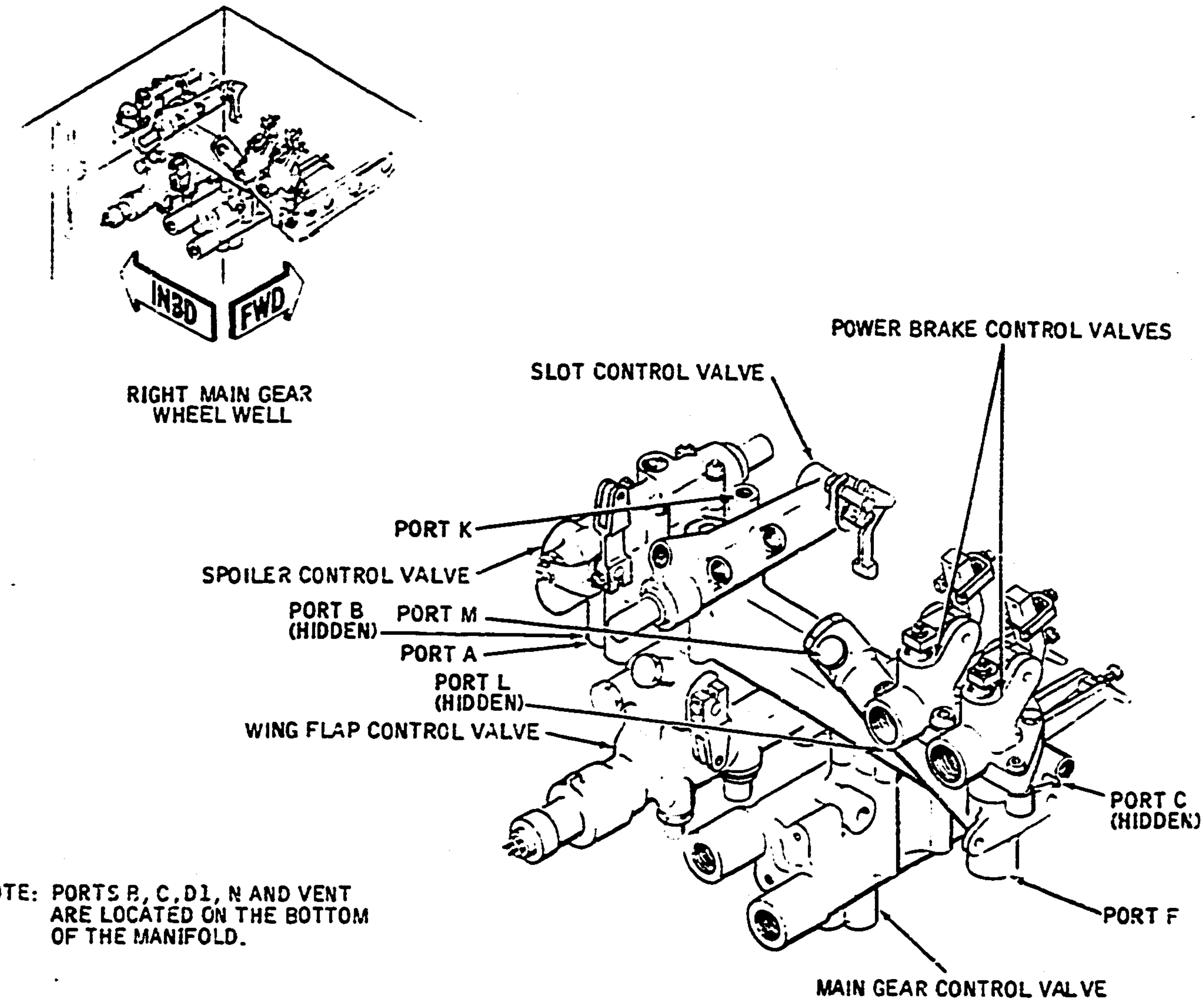
Left Hydraulic Power Manifold -- Schematic
(Airplanes JA8031-JA8037, JA8040, JA8044,
JA8051 and Subsequent)
Figure 18 (Sheet 1)

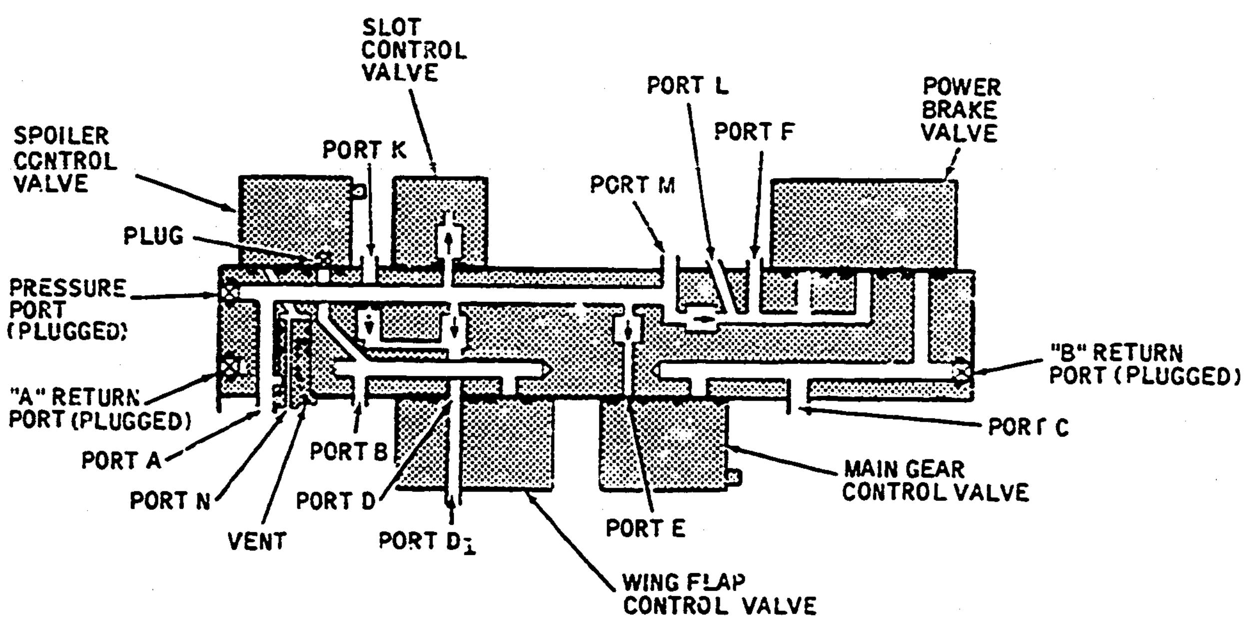




HA2-28

Left Hydraulic Power Manifold -- Schematic
(Airplanes JA8038, JA8039, JA8041-JA8043, JA8045-JA8048)
Figure 18 (Sheet 2)





HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19

in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Hydraulic Manifold Return Check Valves, Airplanes JA8038, JA8039, JA8041-JA8043, JA8045-JA8048 (See Figure 10.)

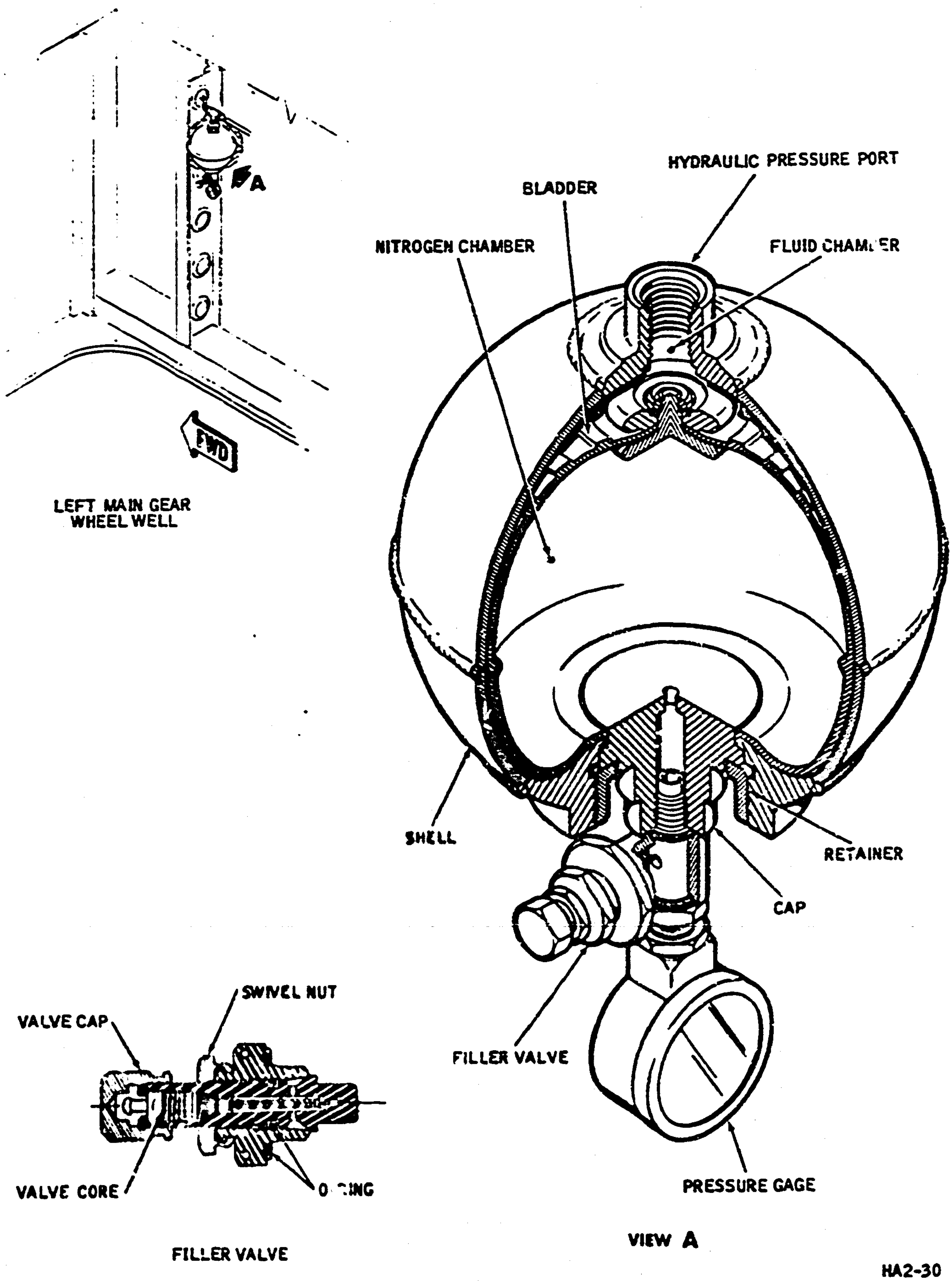
(1) The hydraulic manifold return check valve is installed in the hydraulic reservoir A return line to prevent reverse flow of fluid. This check valve is located on the shear web near the dual filter and relief valve. Access to the check valve is through the left main gear inboard door.

(2) The direction of flow is marked on one surface, and the rating of the check valve (1500 psi) is marked on the other surface.

S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.



Hydraulic Power System Accumulator -- Cutaway View
Figure 20

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

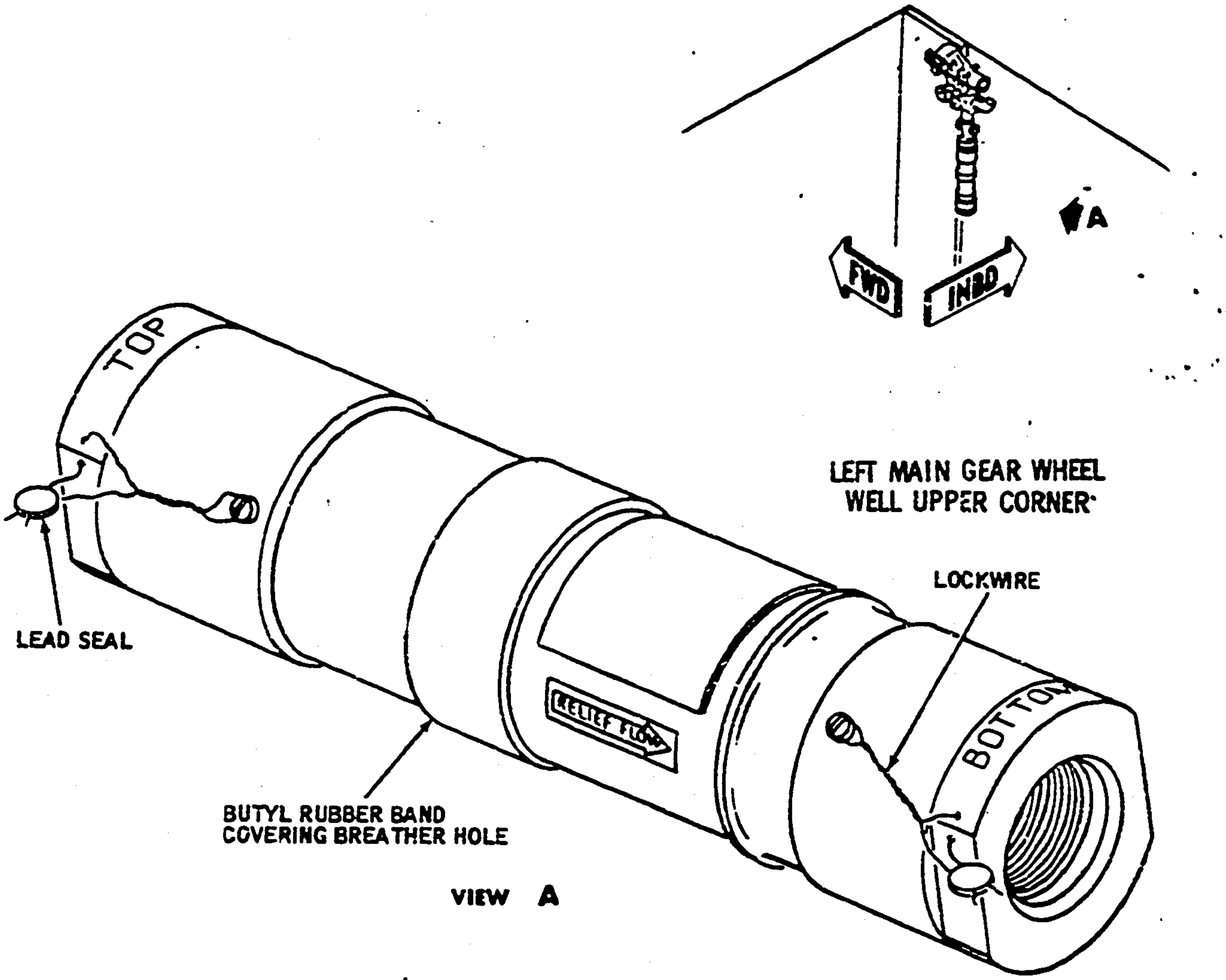
T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystem downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applied pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.



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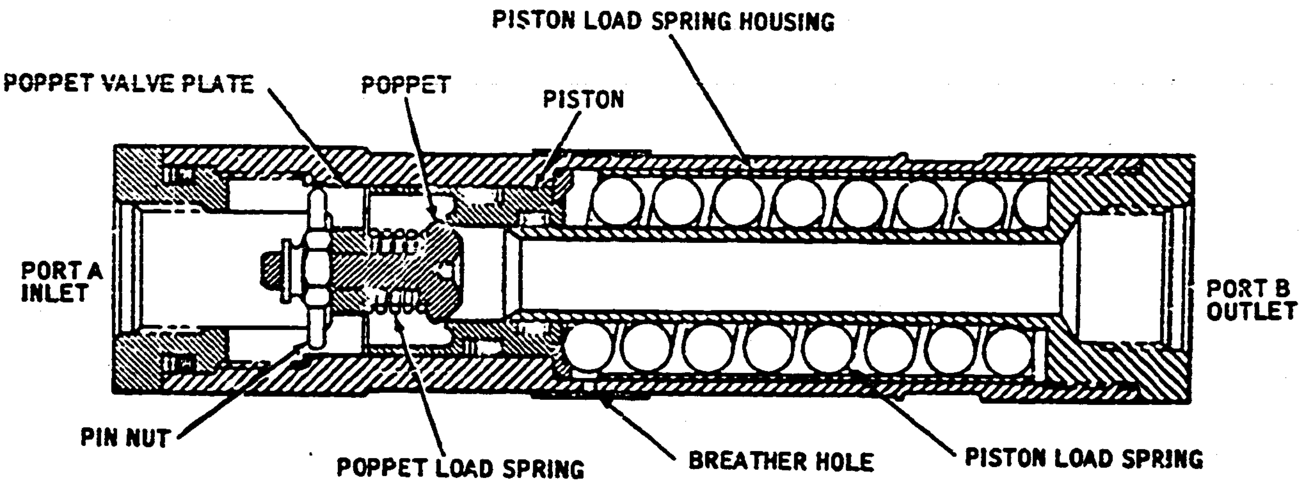

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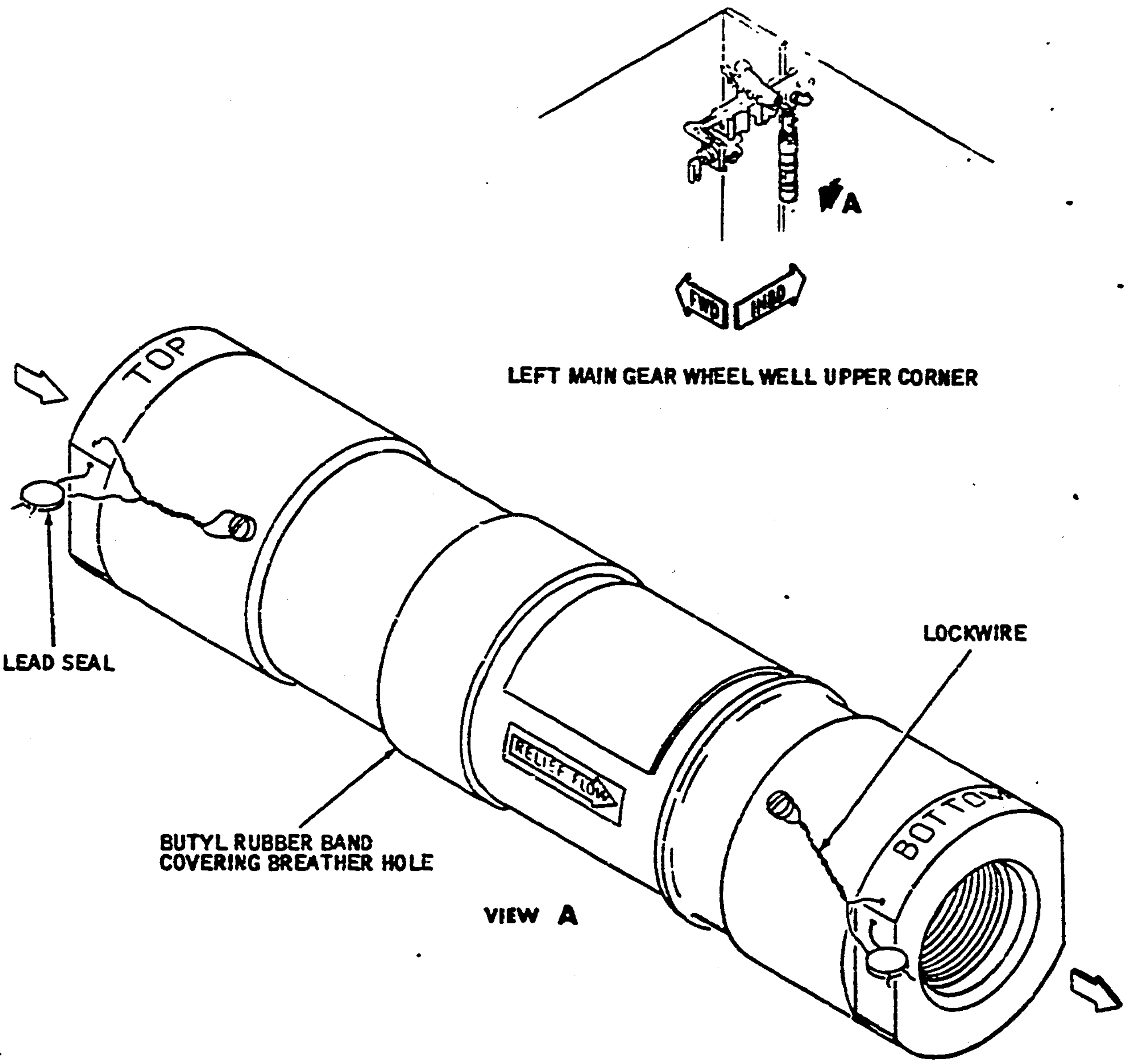
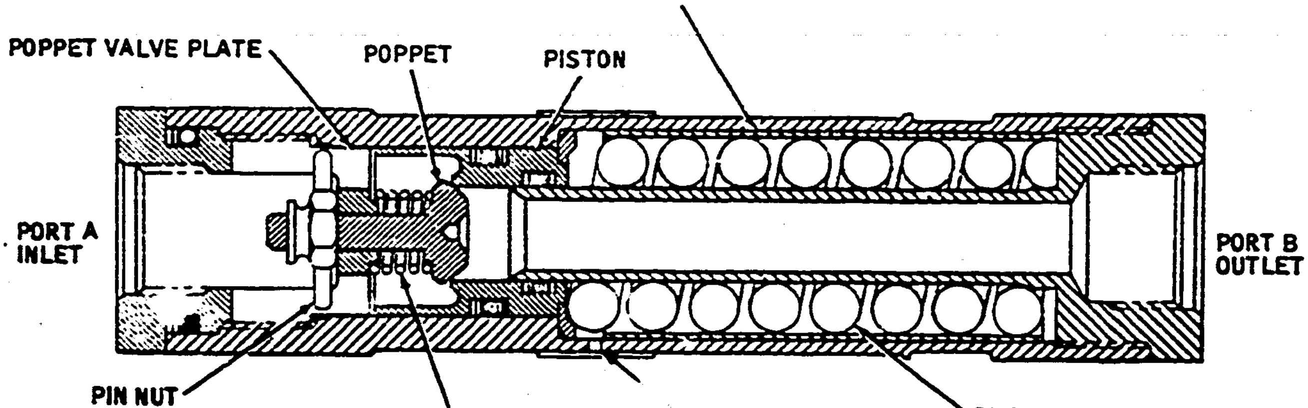
Hydraulic System Priority Valve — Cutaway View
(Airplanes JA8031-JA8037, JA8040, JA8044,
JA8051 and Subsequent
Figure 21 (Sheet 1)





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Hydraulic System Priority Valve — Cutaway View
(Airplanes JA8038, JA8039, JA8041-JA8043, JA8045-JA8048)
Figure 21 (Sheet 2)

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation. To prevent reversion to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear down lock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector

valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

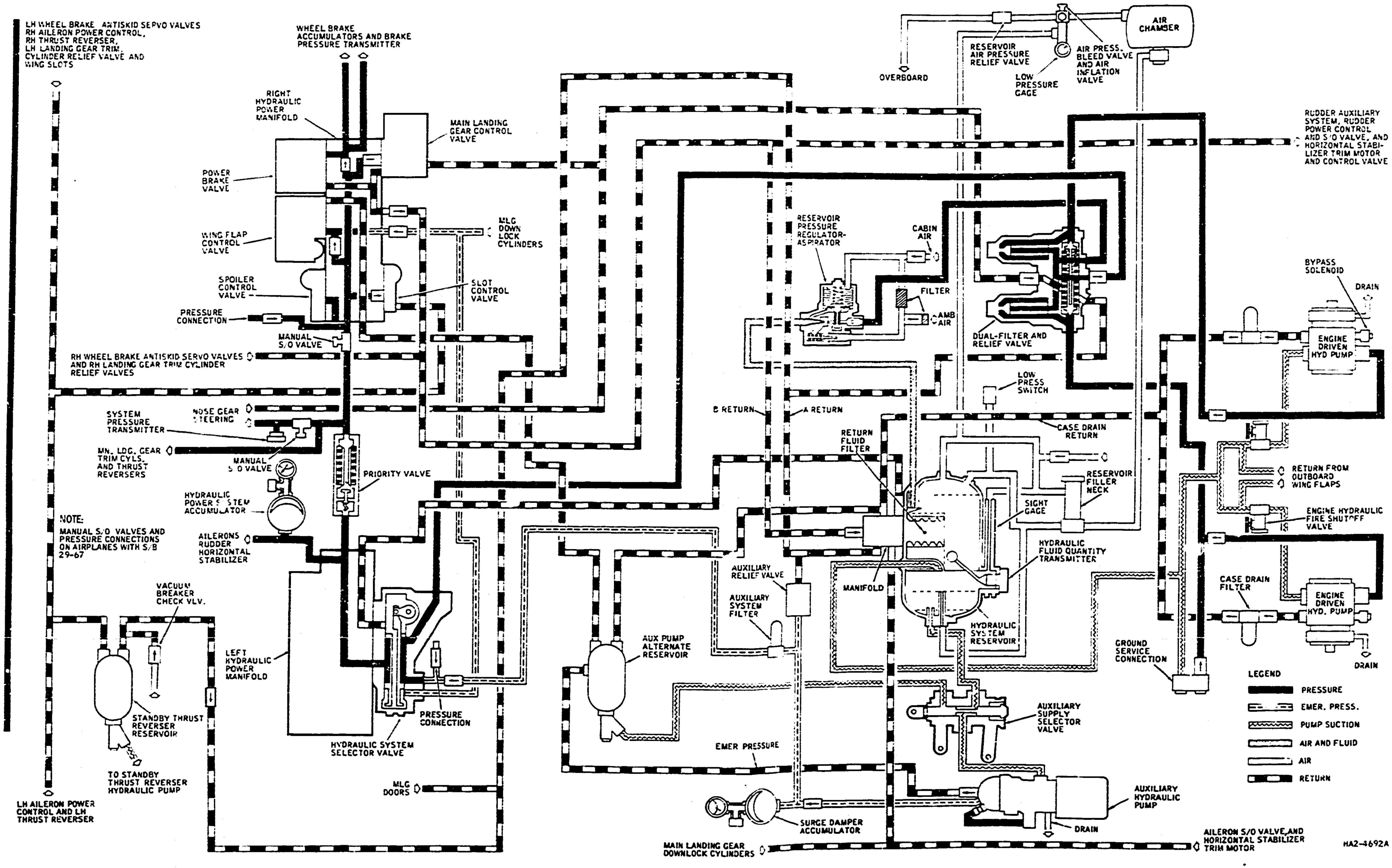
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

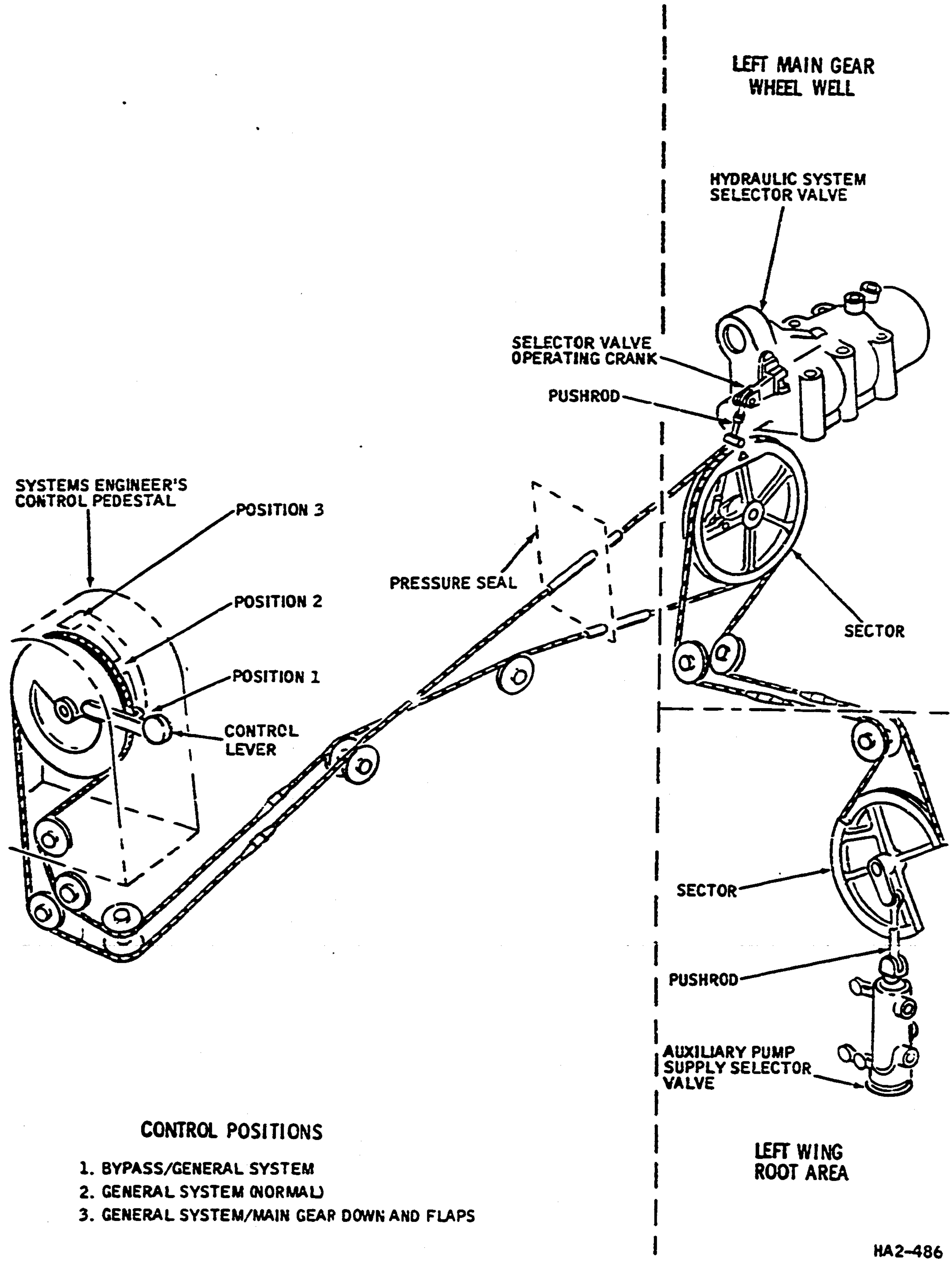
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram
Figure 1



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

back to the reservoir via a return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff.

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake.

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

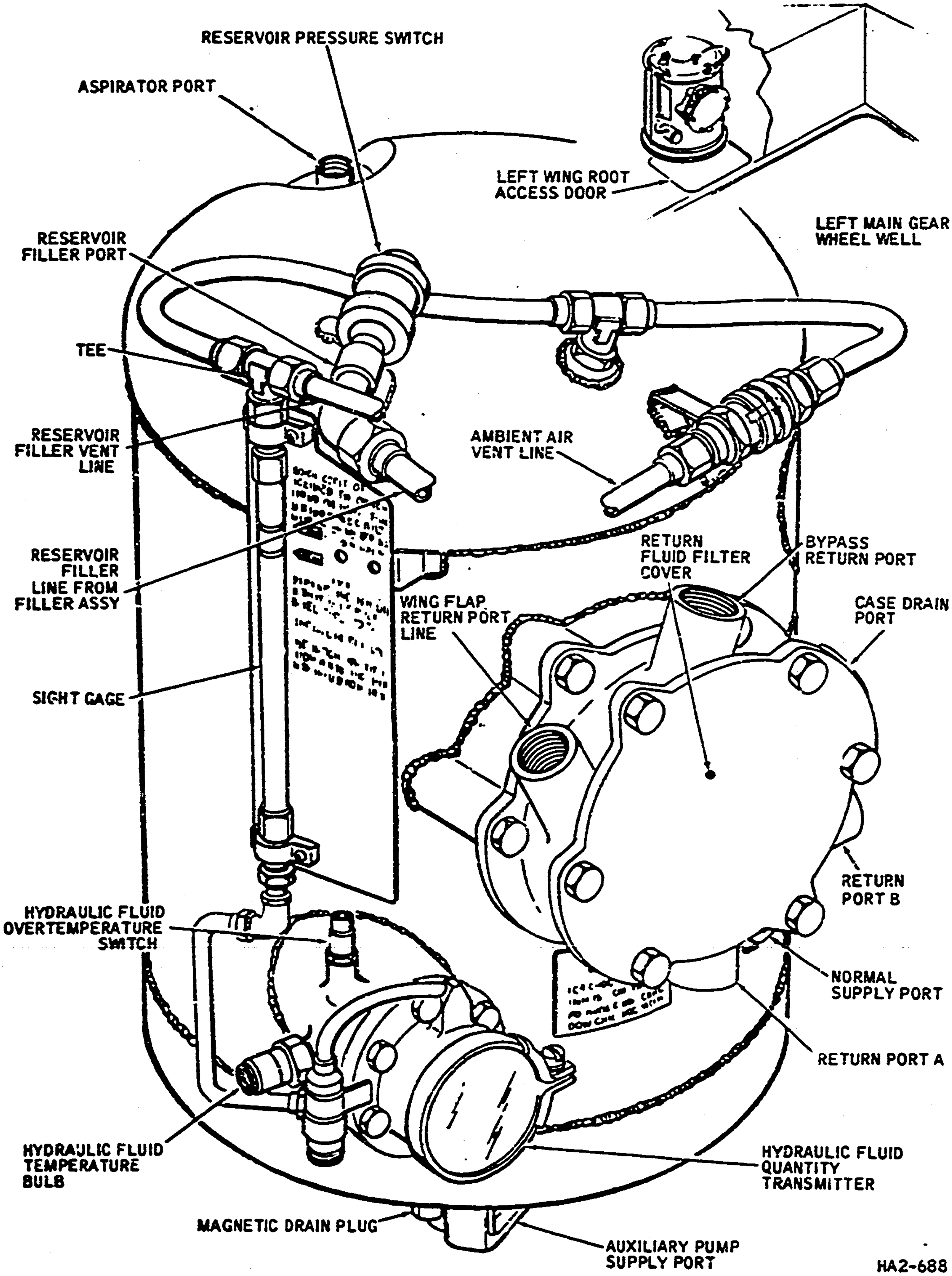
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

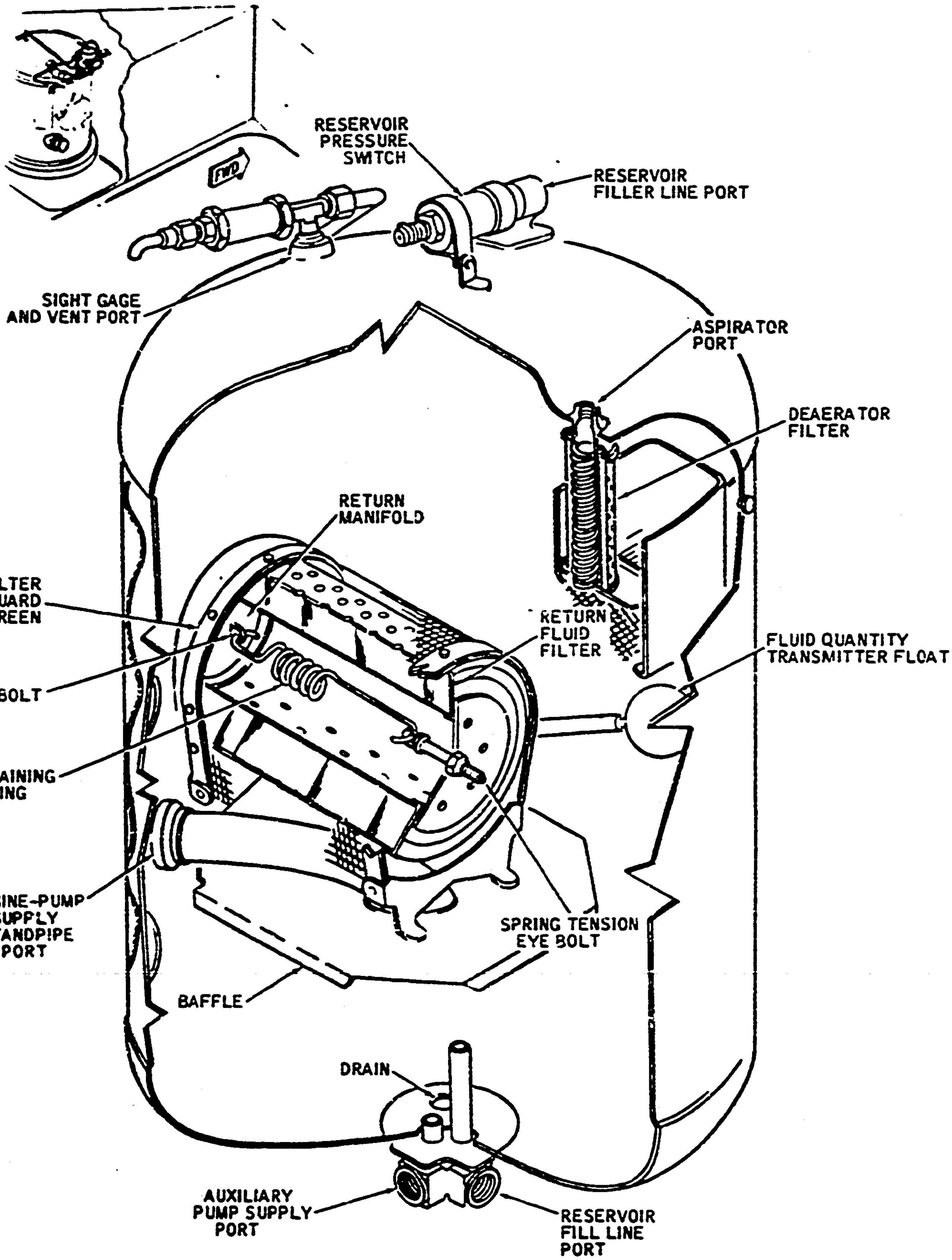
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

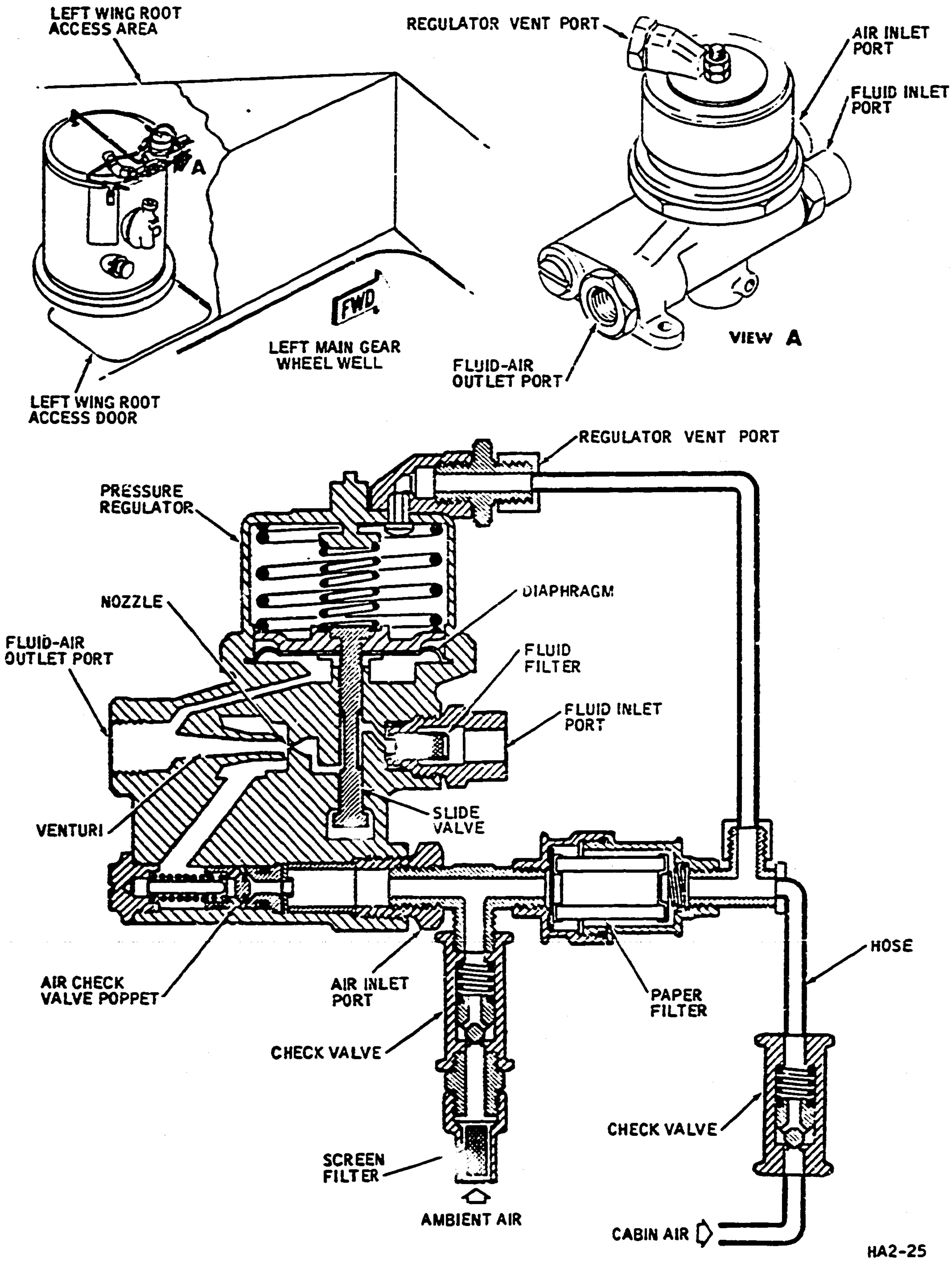
(3) Internally, the filter has a 10-micron, resin-impregnated convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

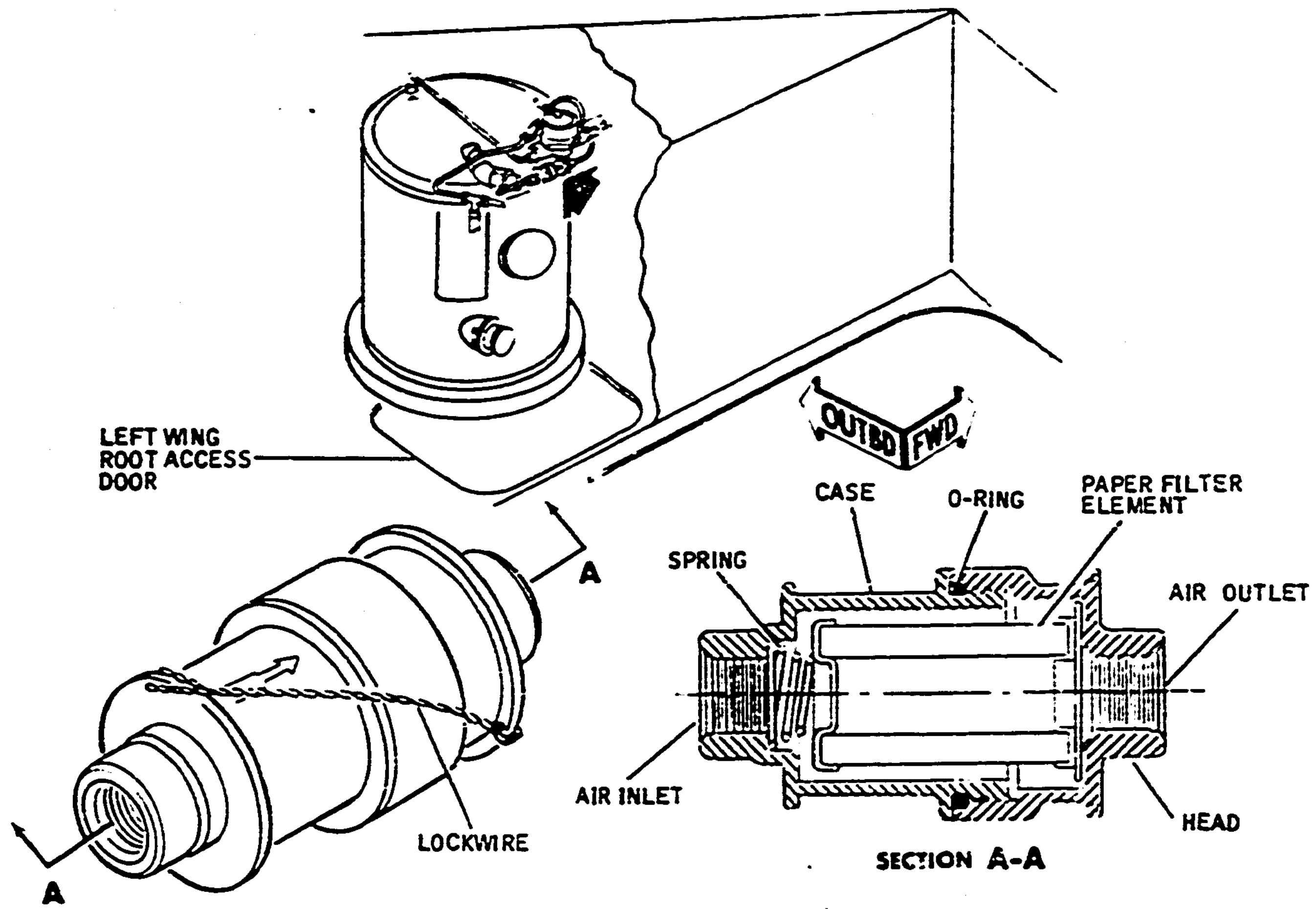
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

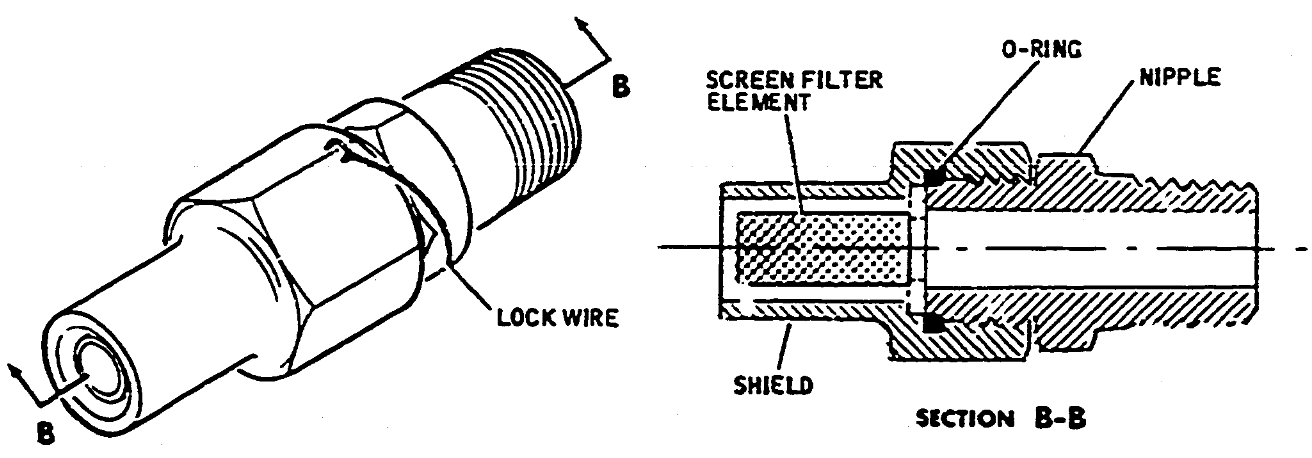
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.



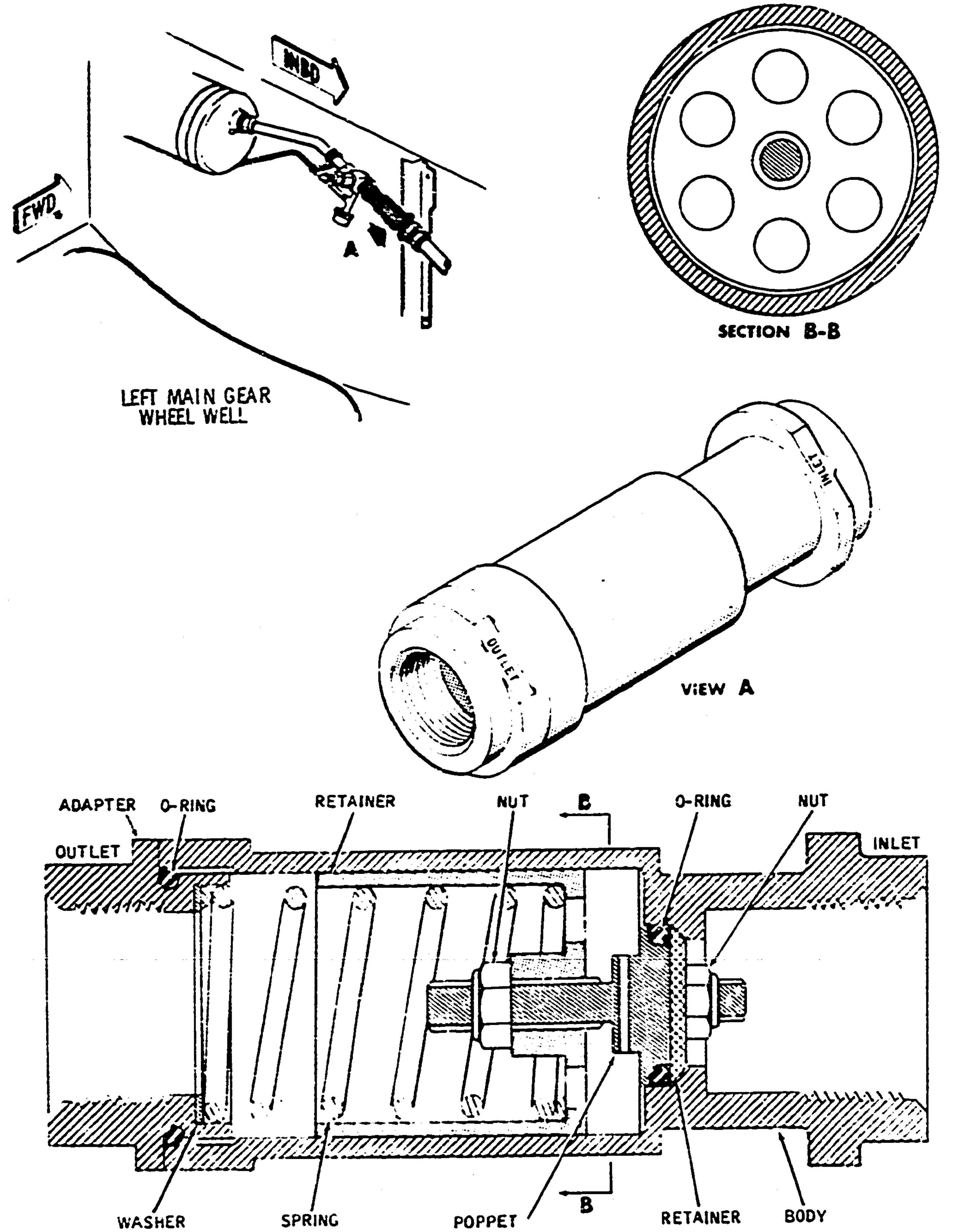
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



HA2-17

Hydraulic Reservoir Relief Valve
Figure 7

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

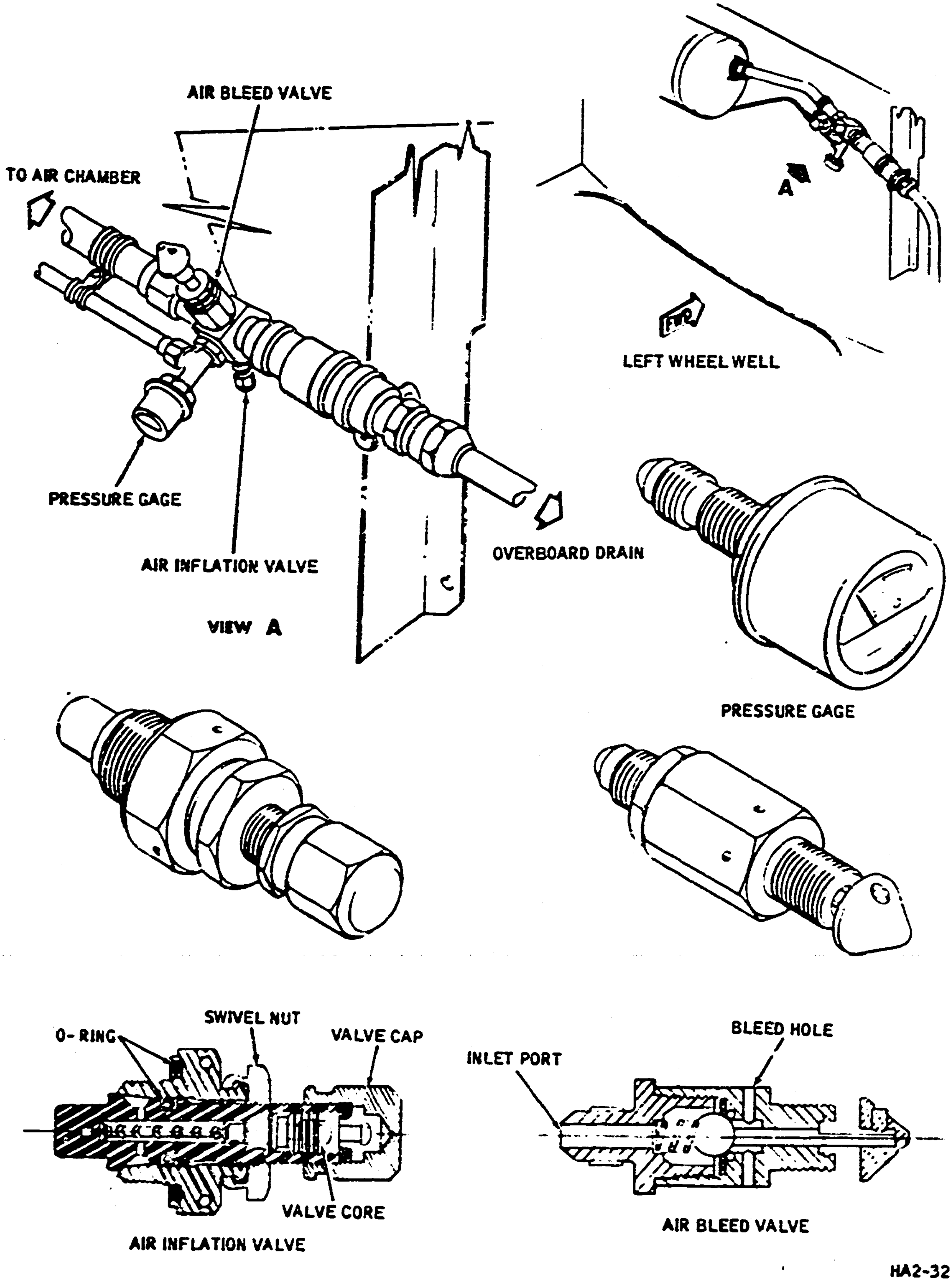
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

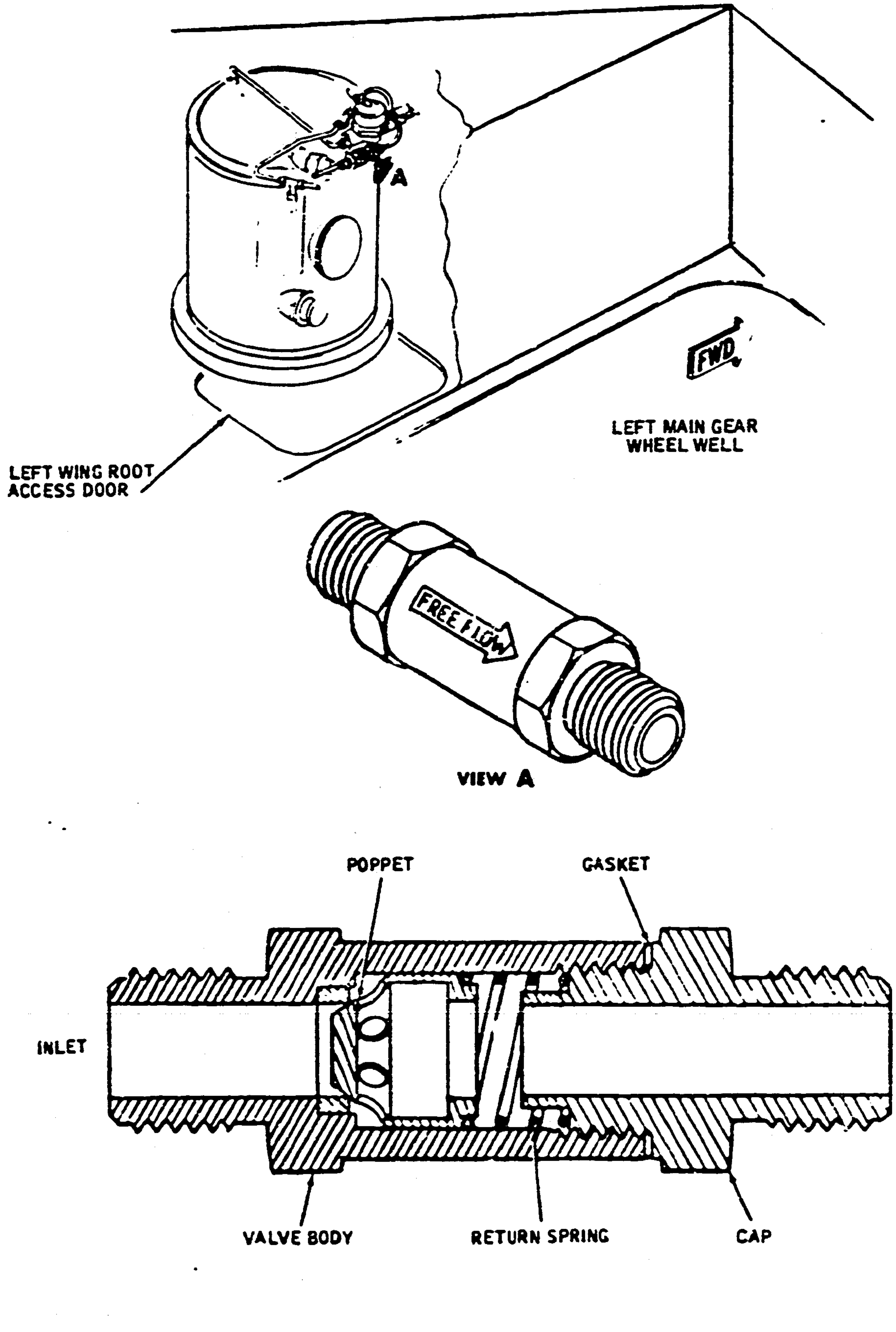
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

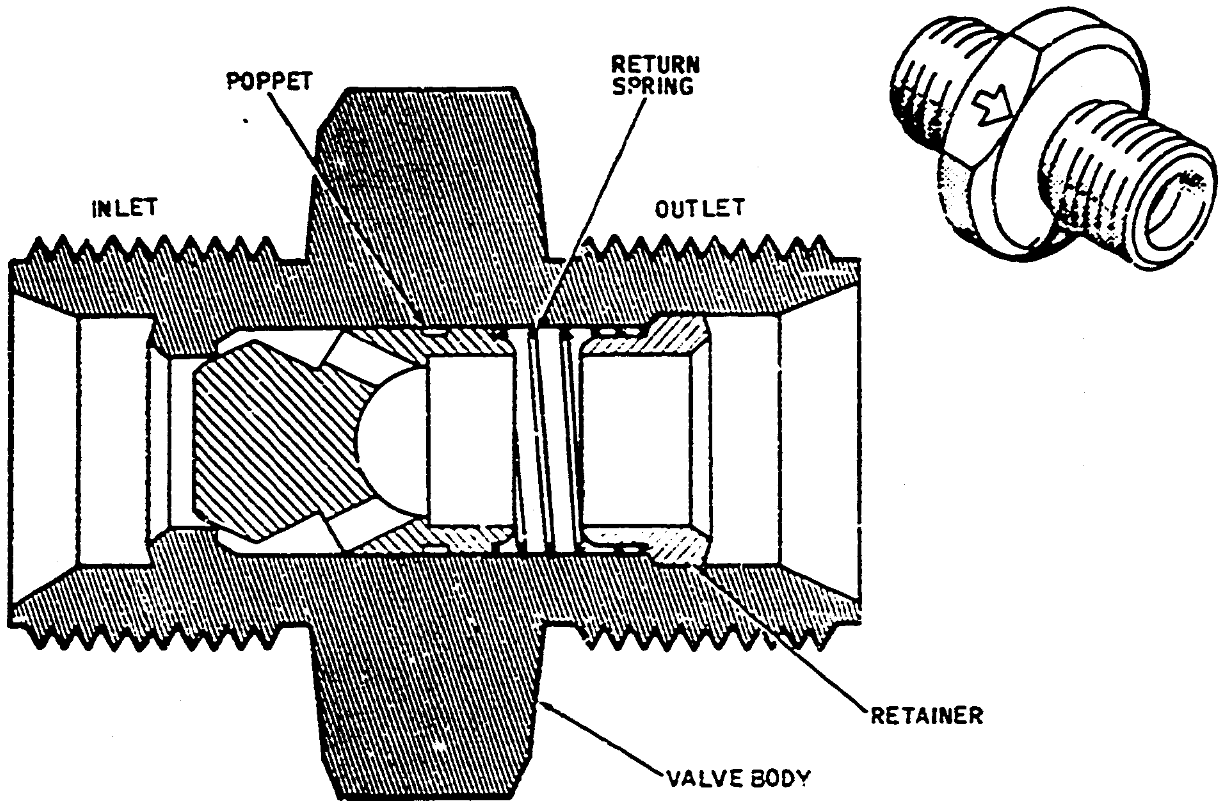
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

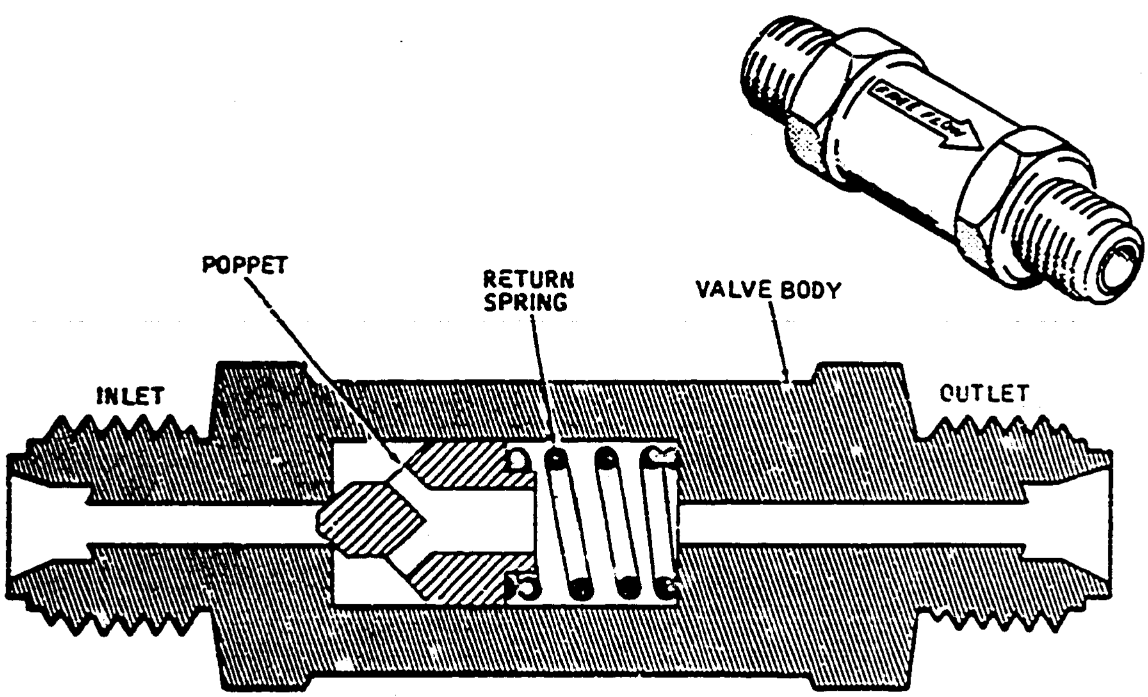
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

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Hydraulic Check Valves -- Typical
Figure 10

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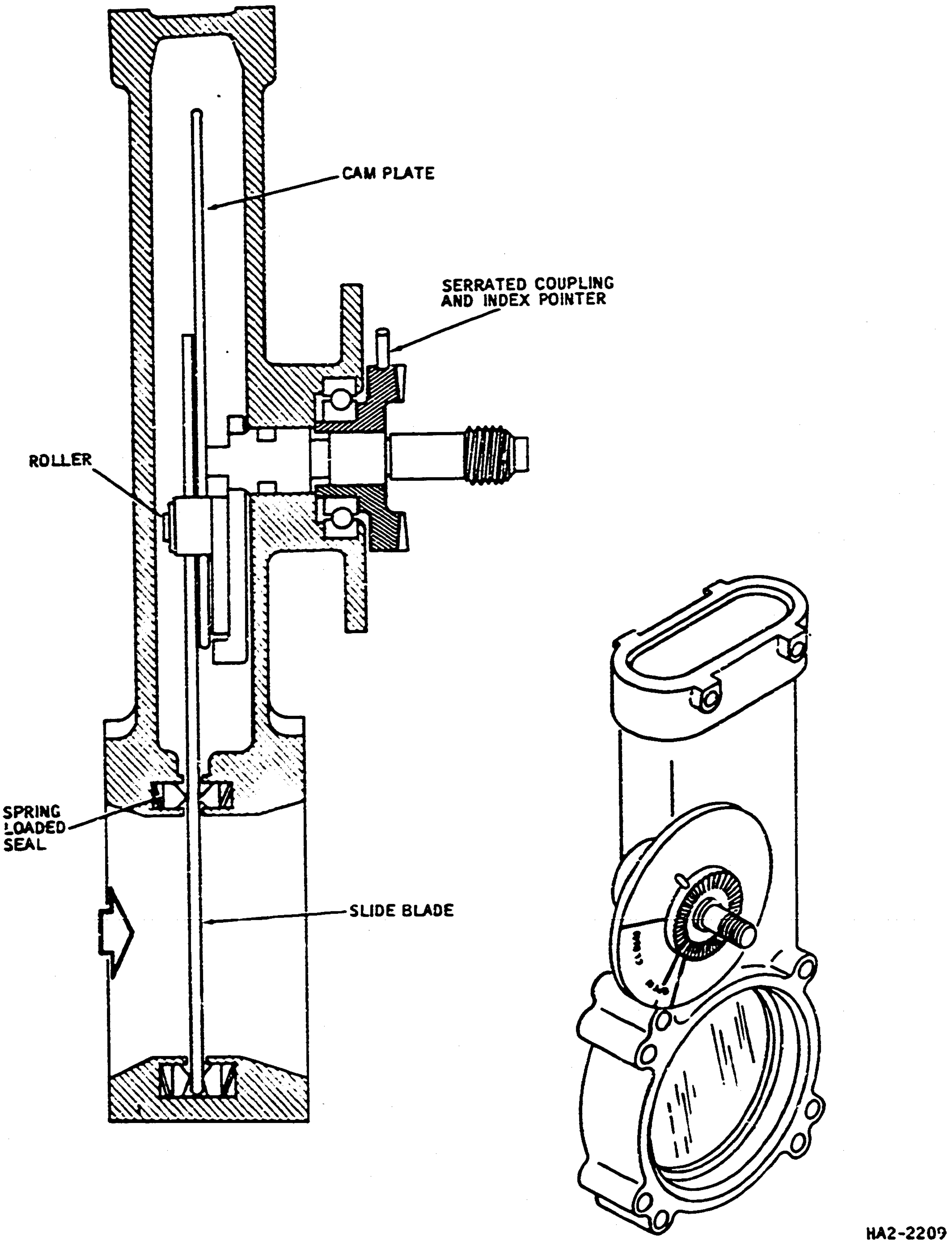
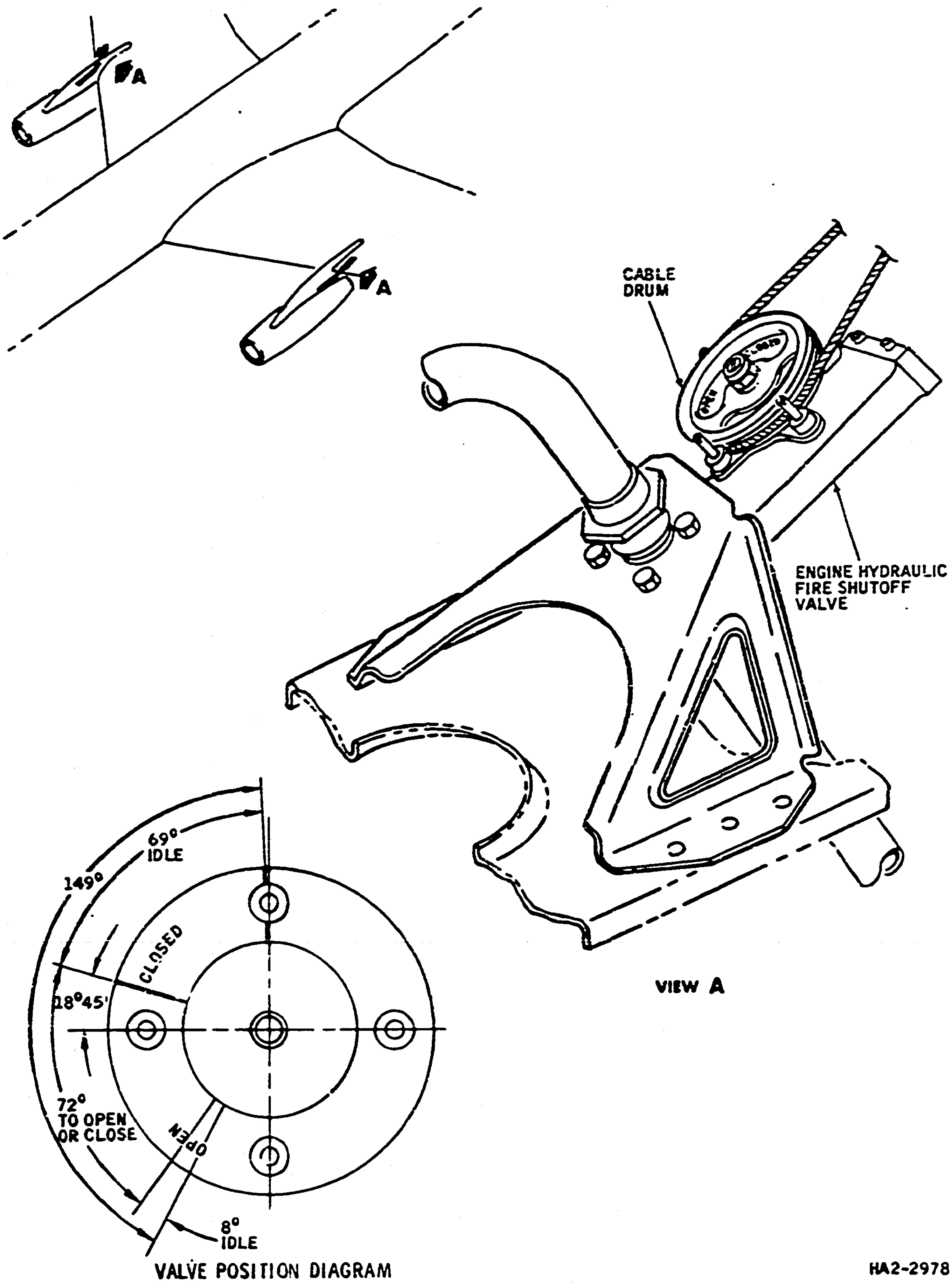


Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve

Figure 12

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

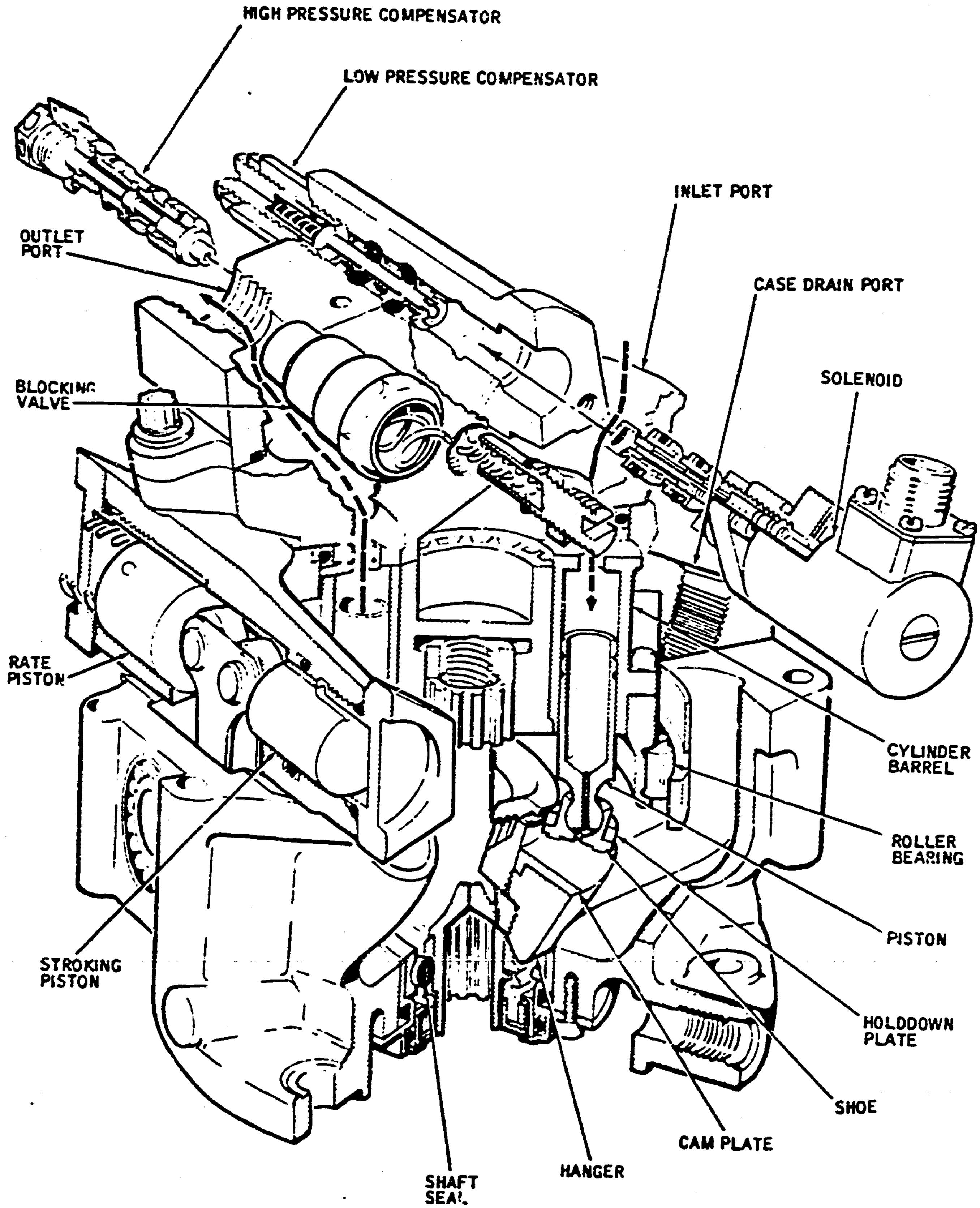
K. Engine-Driven Hydraulic Pump (See Figures 13 and 14.)

(1) The two, single-stage, variable-displacement, cam-actuated, pressure-compensated, engine-driven hydraulic pumps are installed, one each, on the inboard engines. The pump incorporates a solenoid-operated bypass feature for reducing the output pressure to zero psi. Each bypass valve solenoid is controlled by a corresponding engine hydraulic pump control switch in the flight compartment. The switch for the hydraulic pump on engine 2 is placarded left, on, and bypass. The switch for engine 3 is placarded right, on, and bypass. When a switch is placed in the bypass position, the bypass valve for that pump is actuated and the pump pressure is reduced to zero psi. When the switch is placed in the on position, the bypass valve is open and the pump operates normally in a pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system.

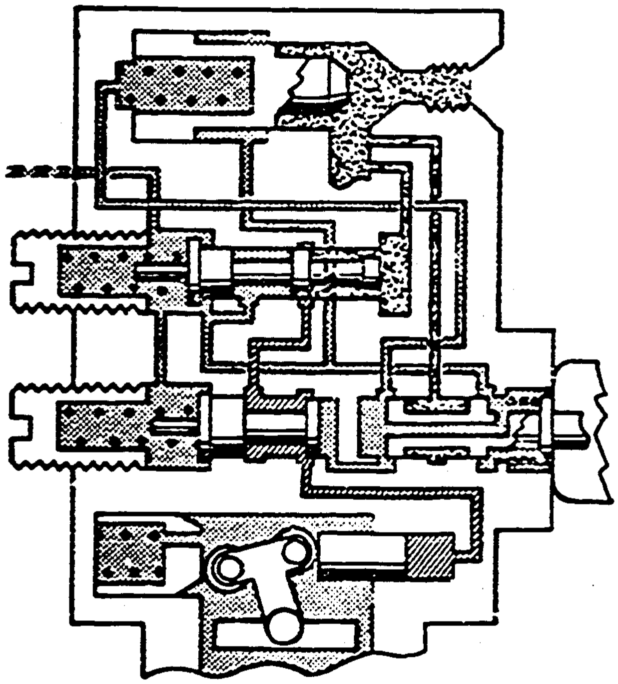
(2) The heart of the pump is a revolving cylinder barrel which contains nine pistons. By means of a hold-down plate and hydraulically balanced shoes, the pistons are supported on an inclined cam plate which causes them to reciprocate as the barrel revolves. The hold-down plate ensures positive stroking of the pistons during the suction stroke. The angle of the cam plate is varied by moving the trunnioned hanger on which it is mounted, thereby changing the displacement of the pump. The hanger, in turn, is controlled by a pressure compensator.

(3) Oil passes through the main inlet and then through porting in the end of the cylinder barrel to the cylinders from which the pistons are being withdrawn. As the cylinder barrel revolves, these pistons are forced into their bores and discharge high-pressure oil through porting in the end of the barrel to the outlet port.

(4) The cylinder barrel, supported by a radial bearing, is driven by an internal shaft which passes through the trunnioned hanger. A hydraulically balanced, face-type, carbon shaft seal is used to assure optimum sealing. Sealing pressure increases as case pressure increases, and the seal adjusts itself to compensate for any wear which takes place.

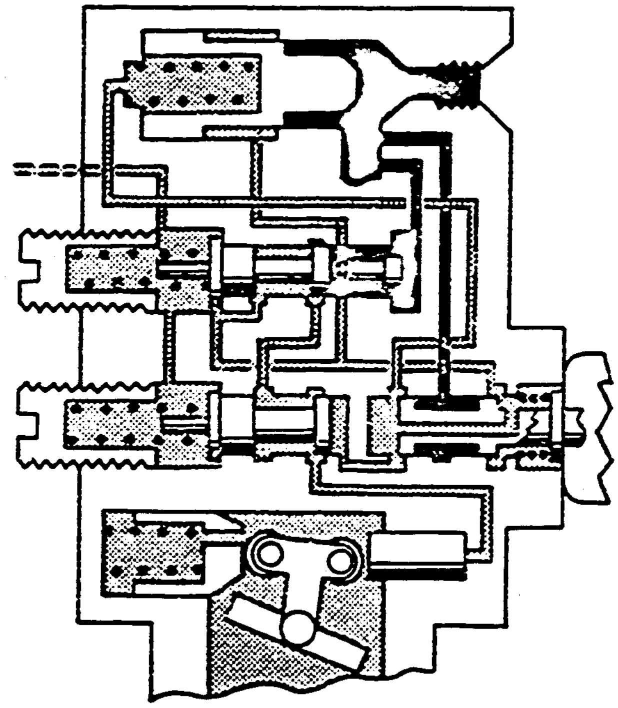


Engine-Driven Hydraulic Pump -- Cutaway View
Figure 13



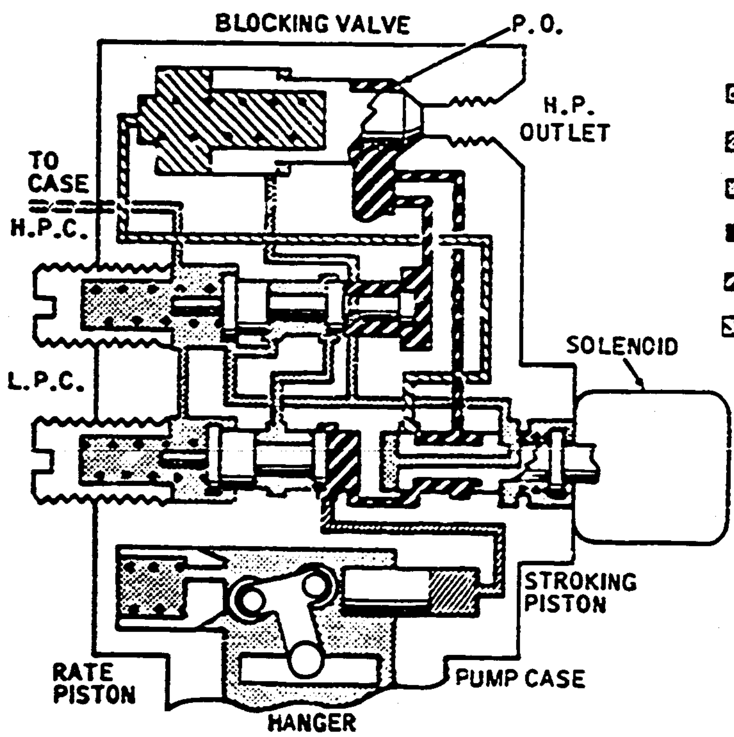
A. FULL PRESSURE, NO FLOW CONDITION

BLOCKING VALVE OPEN, 3,000 PSI FLUID AVAILABLE, NO DEMAND.



B. FULL FLOW CONDITION

BLOCKING VALVE OPEN, HANGER "ON STROKE" 3,000 PSI FLUID FLOWING FROM PUMP.



C. DEPRESSURIZED AND BLOCKED CONDITION

SOLENOID ENERGIZED, BLOCKING VALVE CLOSED, PUMP COMPENSATED AT 500 PSI.

KEY

- COMPENSATED PRESSURE: 3,000 ± 50
- CONTROL PRESSURE: 200-300
- CASE PRESSURE: 45-55
- FULL FLOW PRESSURE: TO 2,950
- DEPRESSURIZED PRESSURE: 400-500
- BLOCKING VALVE PRESSURE: 400-500

P.O. = PUMP OUTLET
H.P.C. = HIGH PRESSURE COMPENSATOR
L.P.C. = LOW PRESSURE COMPENSATOR

HA2-19

Engine-Driven Hydraulic Pump Pressure Flow -- Schematic
Figure 14

(5) The pressure compensator regulates the volume delivered in accordance with the demand of the system and maintains the predetermined pressure. When the pressure is less than the spring load, the spring moves the spool to vent oil in the stroking cylinder to the case. The stroking piston then retracts and a spring load on the hanger moves it to a greater angle and increases the volume pumped. The axial thrust of the pistons against the cam plate during power stroke is balanced hydraulically. Oil, at system pressure, is admitted through holes in the piston and shoe to an undercut area in the face of the piston shoe. The pressure applied to the undercut area, which is slightly less than the piston area, effectively balances the forces so that the shoe is supported on an oil film at all times. Balance is controlled to such a degree that there is no excessive leakage, and high volumetric efficiency is maintained.

(6) The axial thrust of the cylinder barrel is also balanced hydraulically against the port plate.

(7) Because of these features, the axial thrust of the pistons is transferred hydraulically, eliminating the need for antifriction thrust bearings. This increases the reliability factor, if contamination or other adverse conditions exist.

(8) The pump functions as a standard, pressure-compensated pump, when the bypass solenoid is not energized. Energizing the solenoid allows the pump to compensate at a reduced, controlled pressure of approximately 500 psi. Also incorporated in the cap is a blocking valve. The valve shuts off the discharge flow from the pump, when the 500 psi compensating valve takes over as a result of the solenoid being energized. Hence, depressurizing the pump permits operation with the pump completely feathered at approximately 1/2 drive torque required at 3000 psi. The blocking valve is automatically controlled by the depressurizing valve. When the solenoid is energized, the blocking valve prevents flow from the pump discharge port. When the solenoid is deenergized, the blocking valve automatically opens as the pump builds up pressure to match the system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 15.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

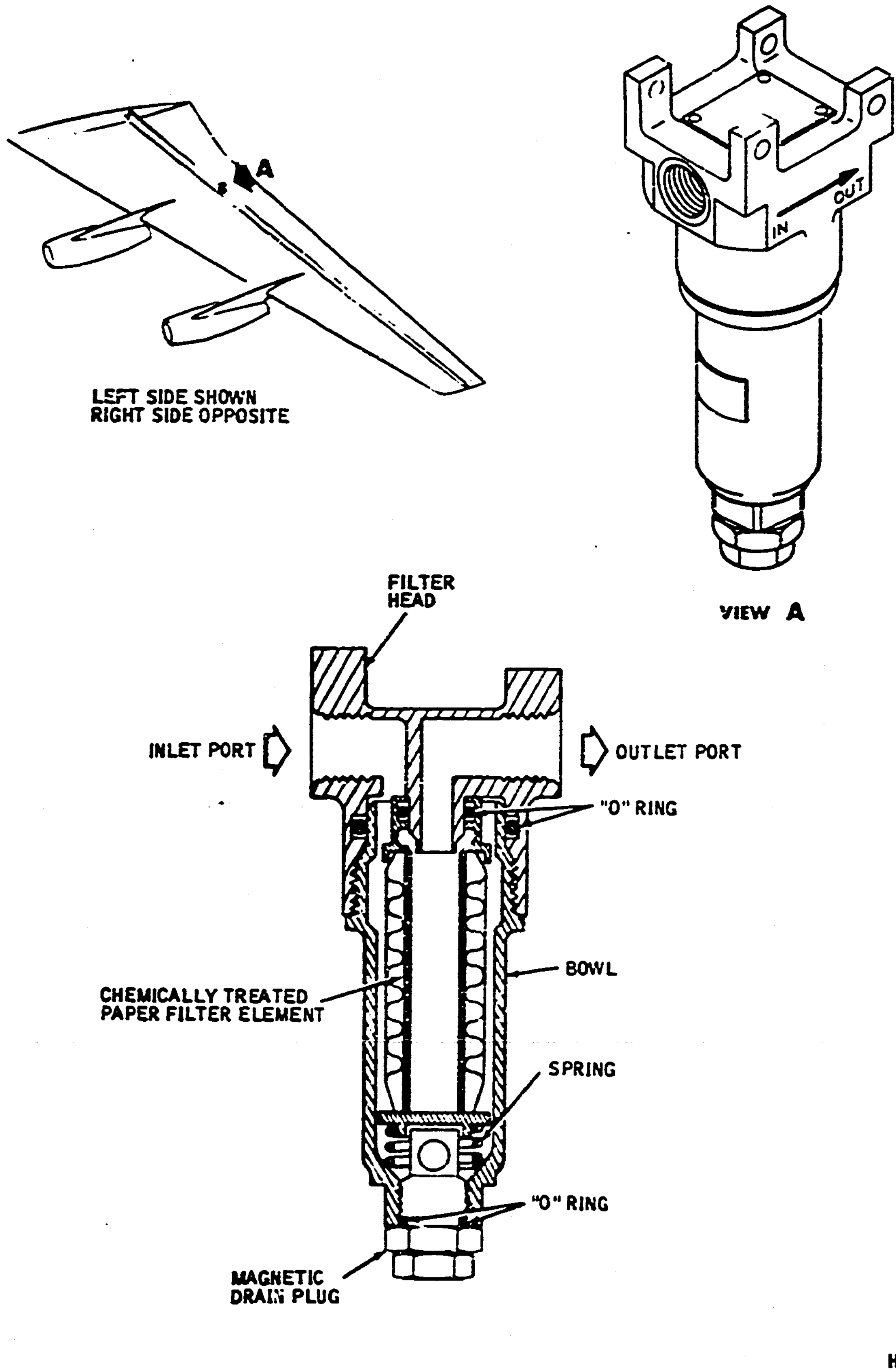
N. Dual Filter and Relief Valve (See Figure 16.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3000 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.



Engine-Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 15

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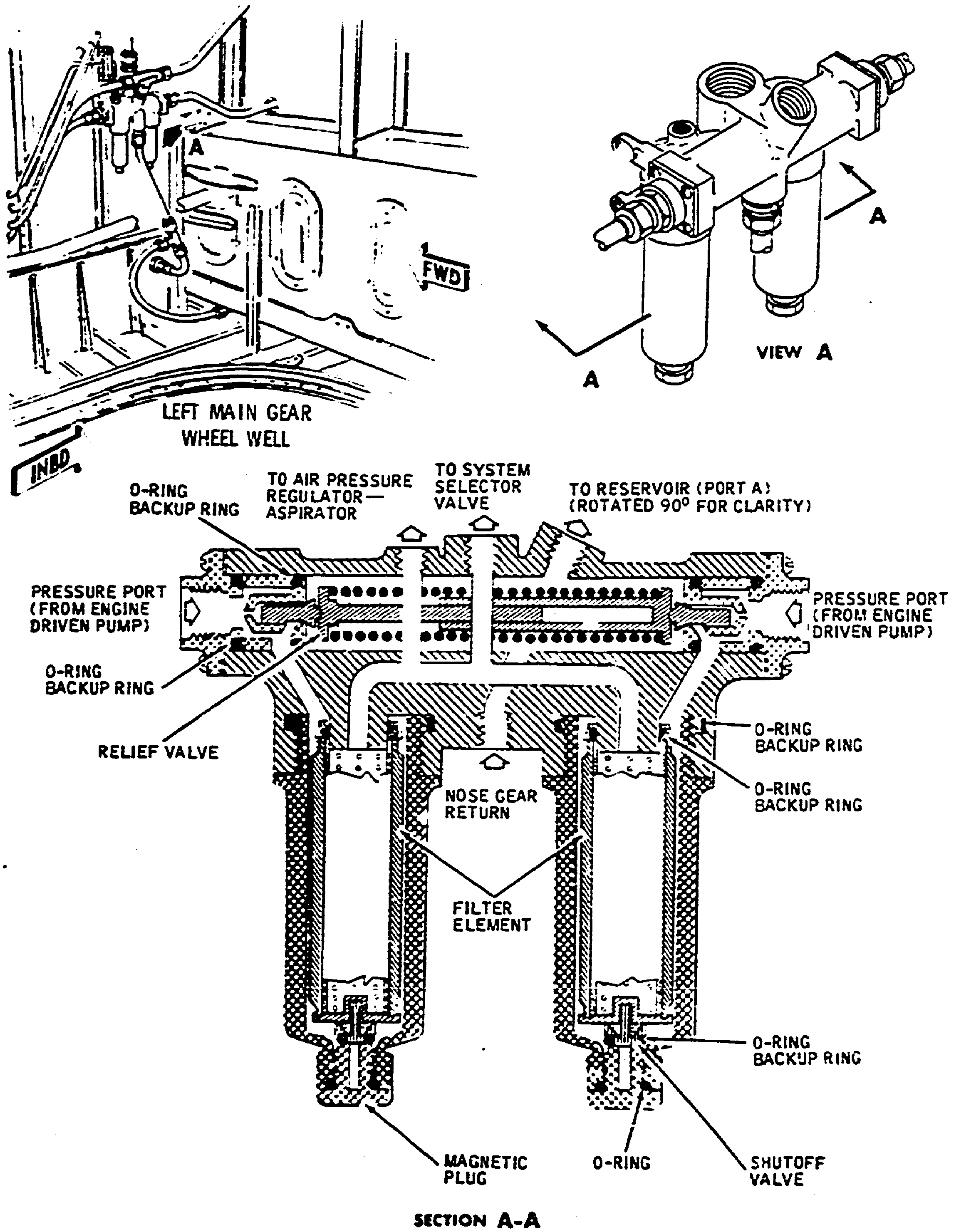

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Dual-Filter and Relief Valve -- Cutaway Valve
Figure 16

(5) A check valve is installed in the system selector valve port to prevent reverse flow or pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 17 and 18.)

(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

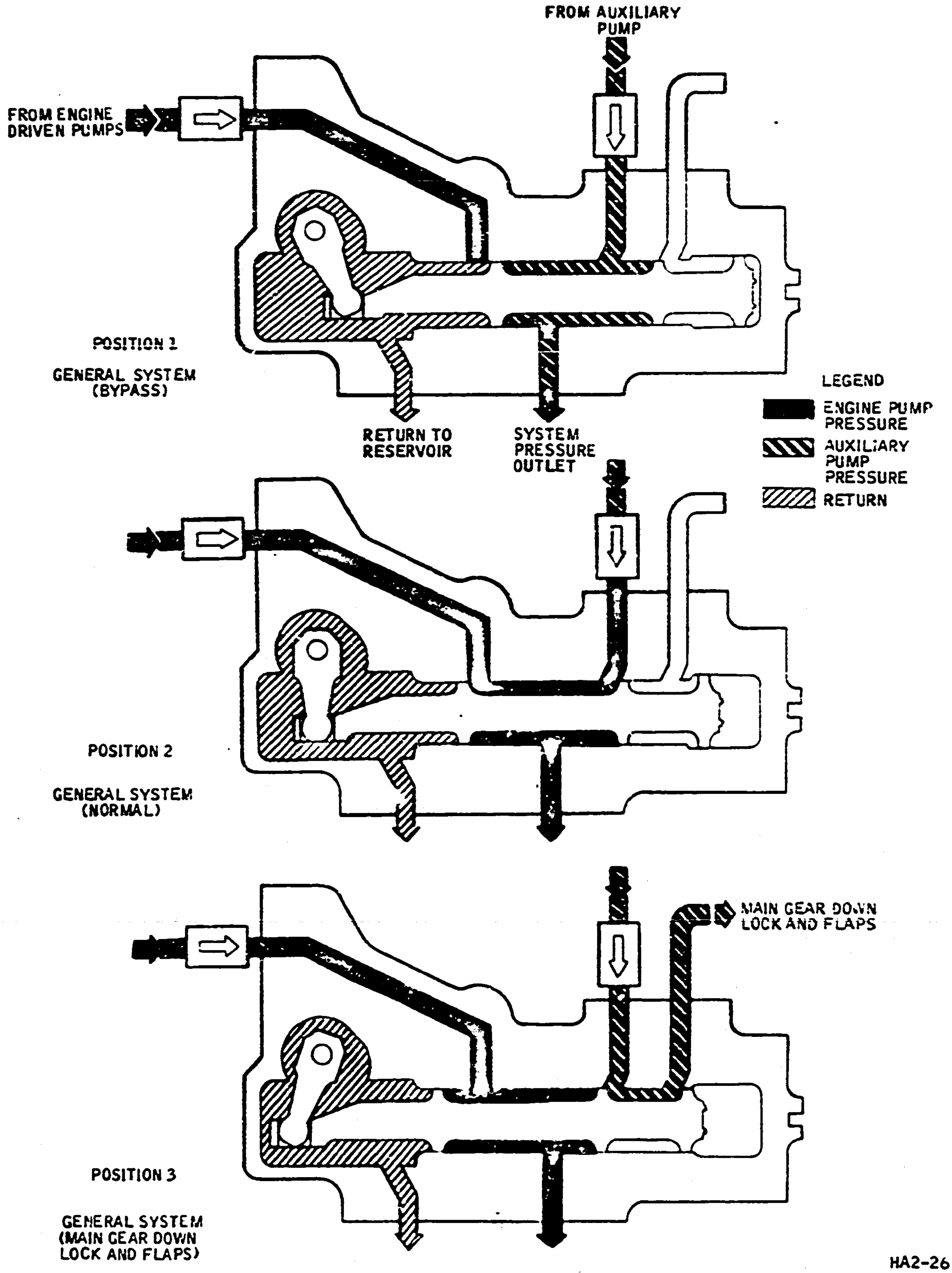
(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear downlock and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 19.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn,



System Selector Valve -- Schematic
Figure 17

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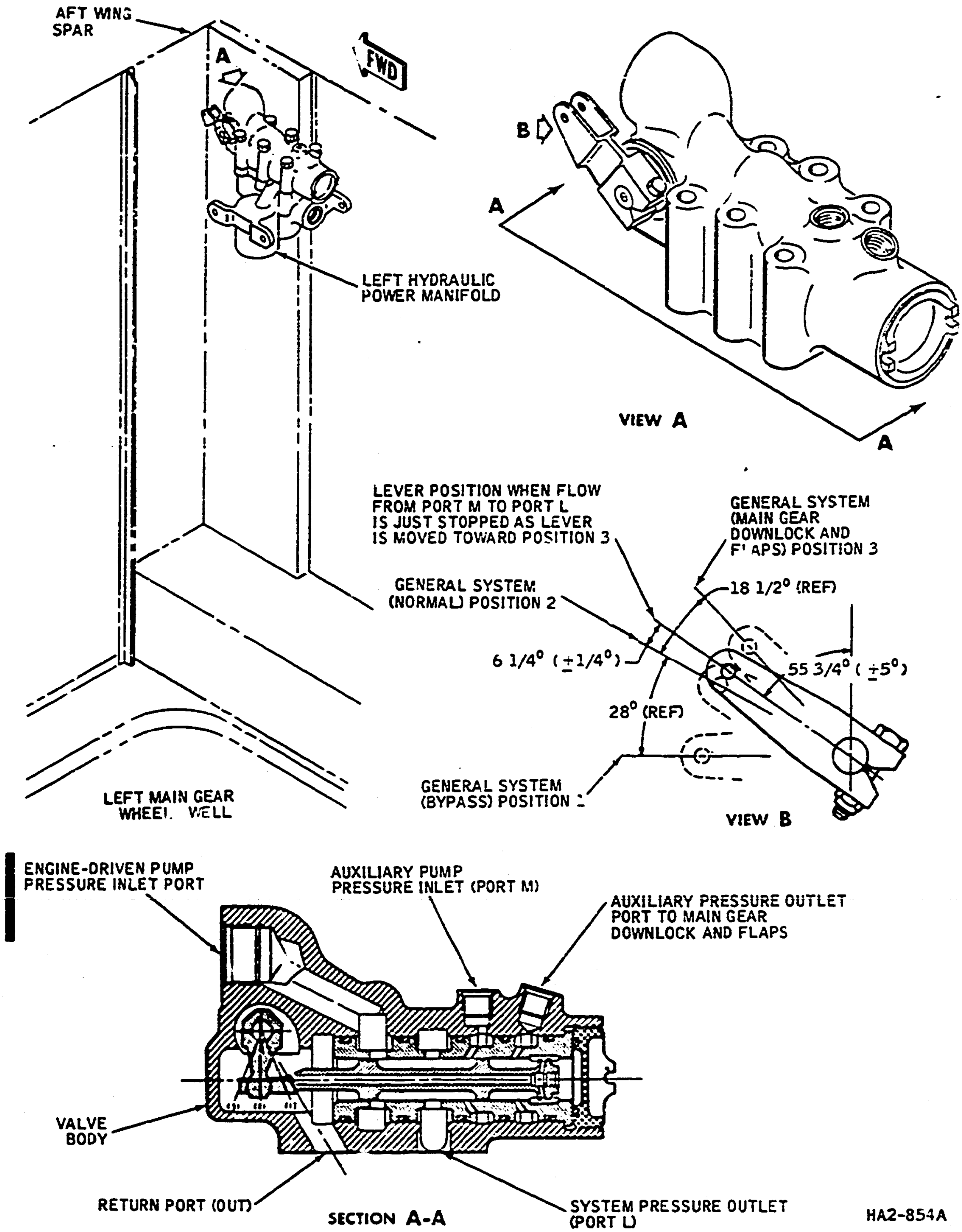
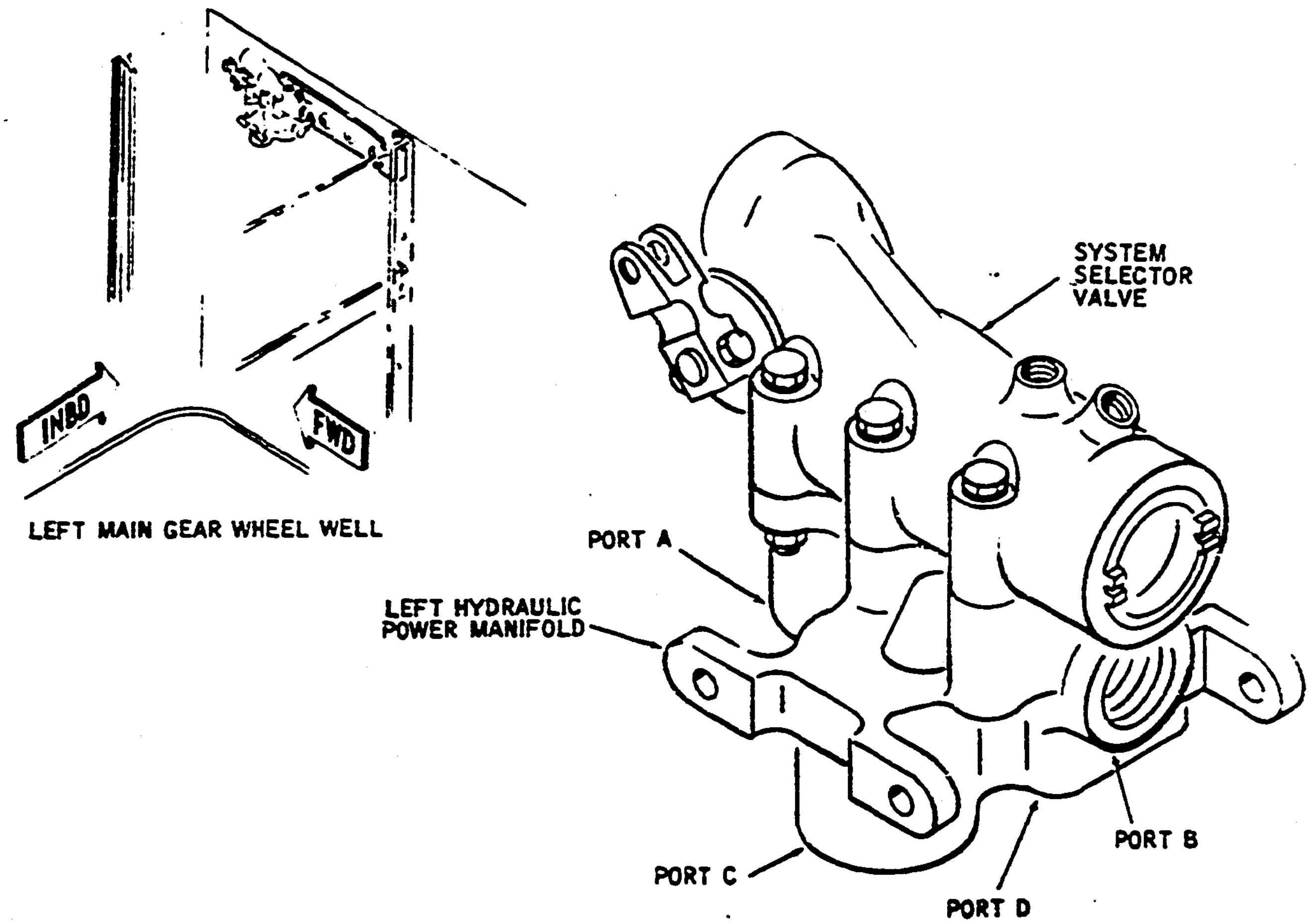
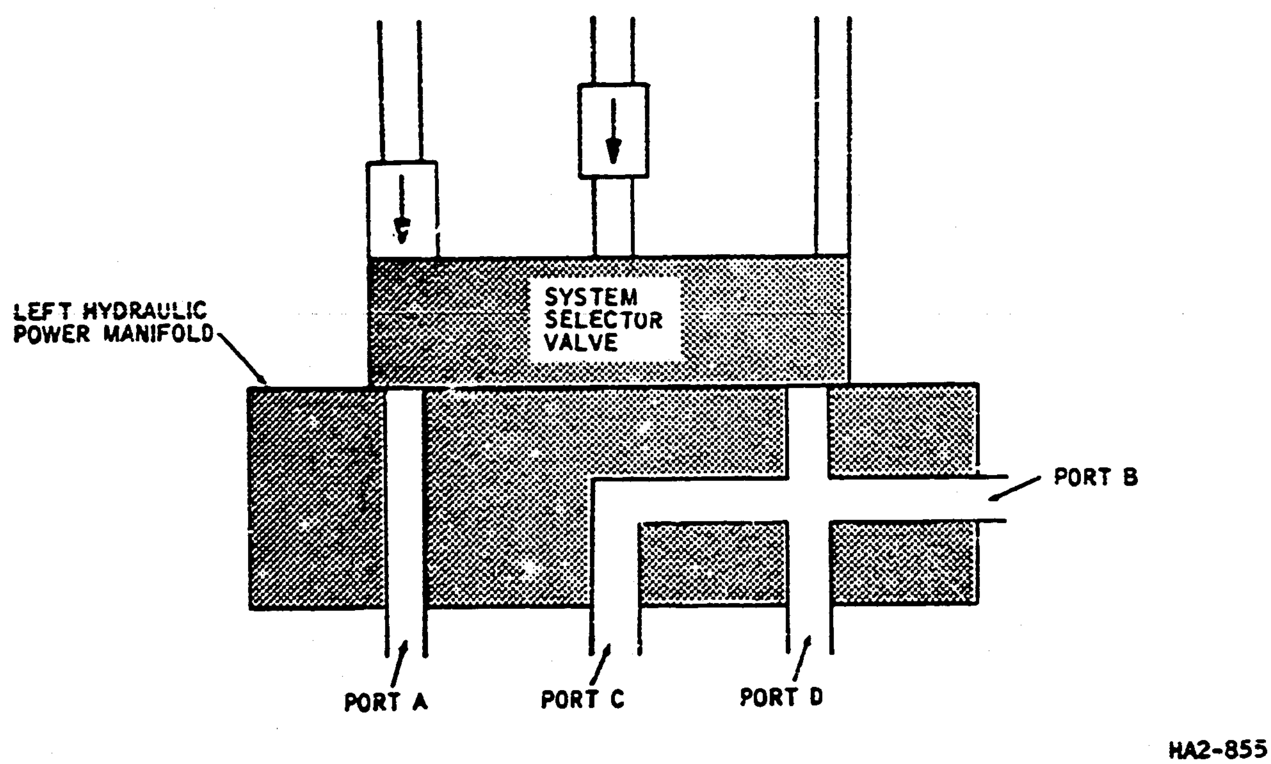


System Selector Valve -- Cutaway View
Figure 18





Left Hydraulic Power Manifold -- Schematic
Figure 19

ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

Q. Right Hydraulic Power Manifold (See Figure 20.)

(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

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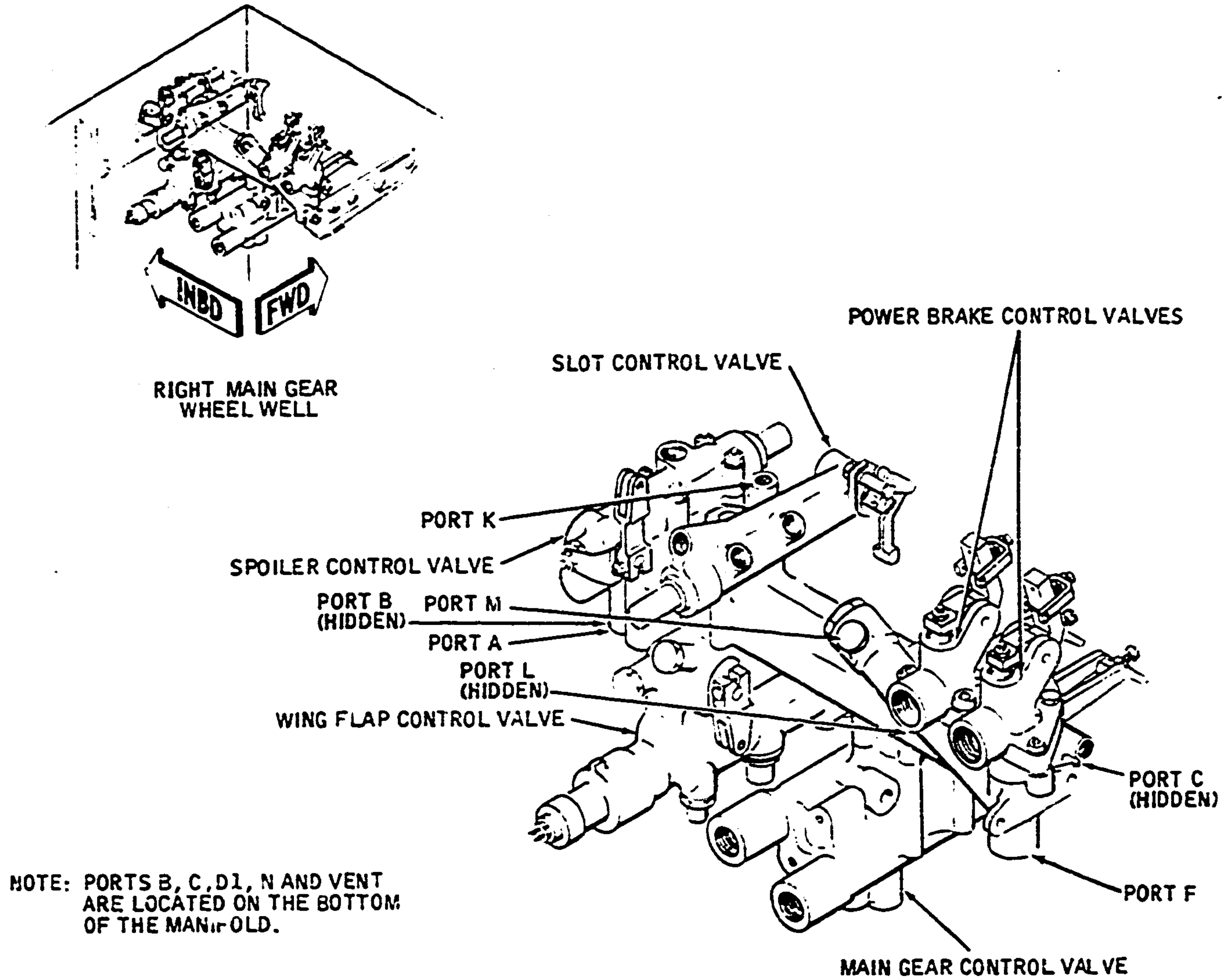

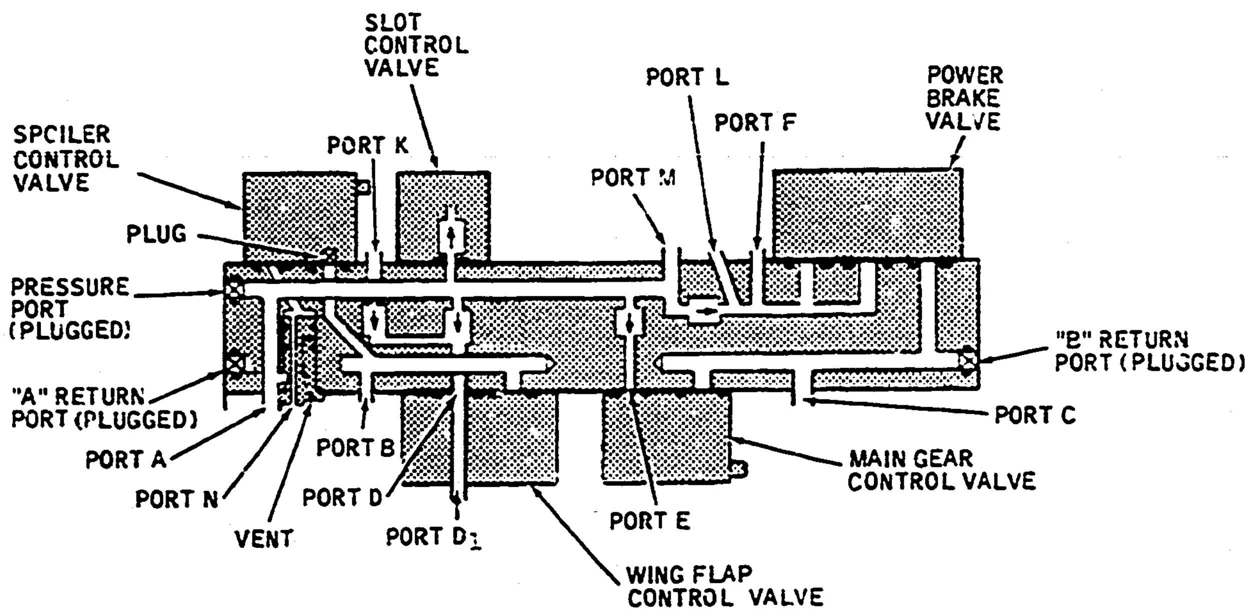

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Right Hydraulic Power Manifold -- Schematic
Figure 20

S. Hydraulic Power System Accumulator (See Figure 21.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

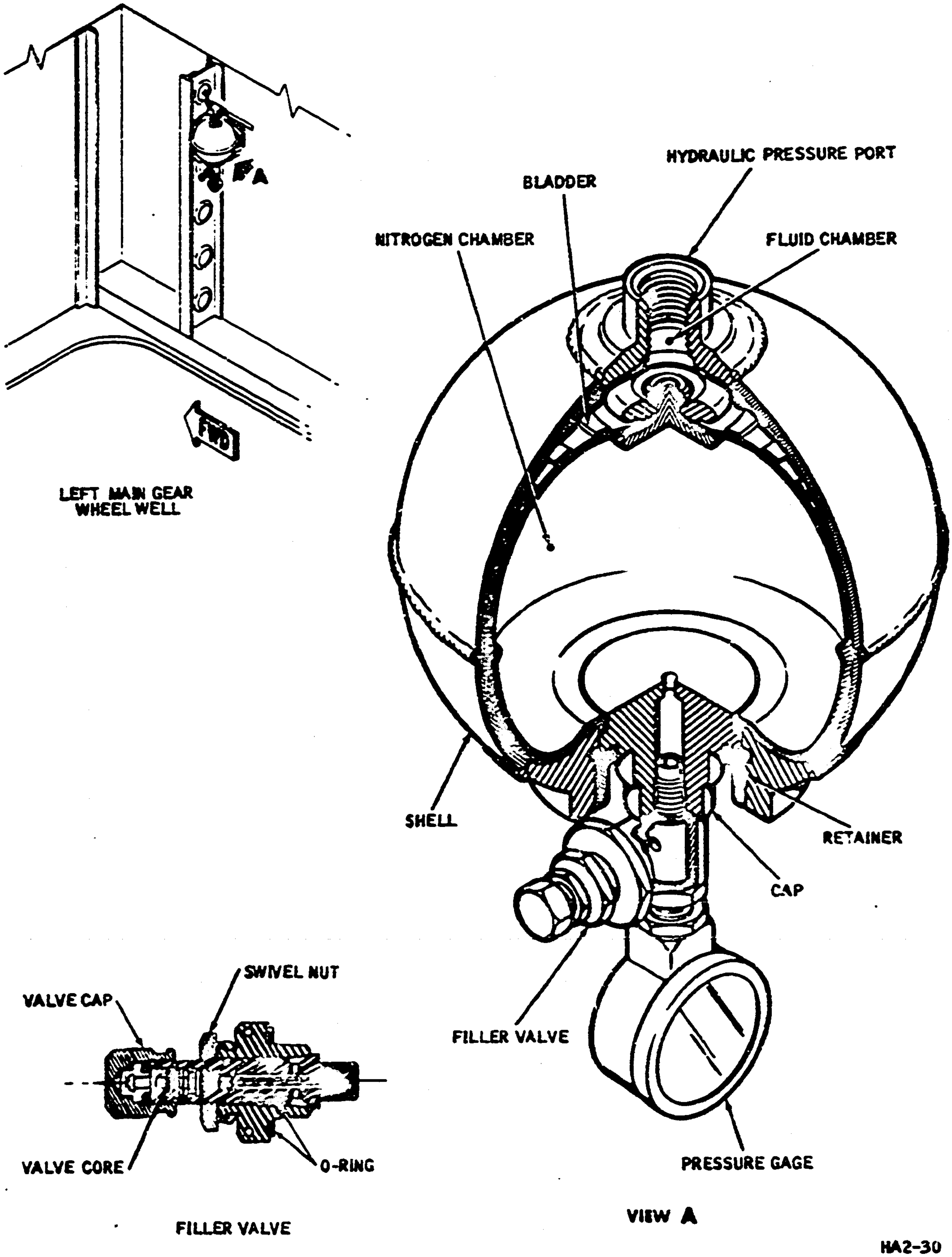
(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

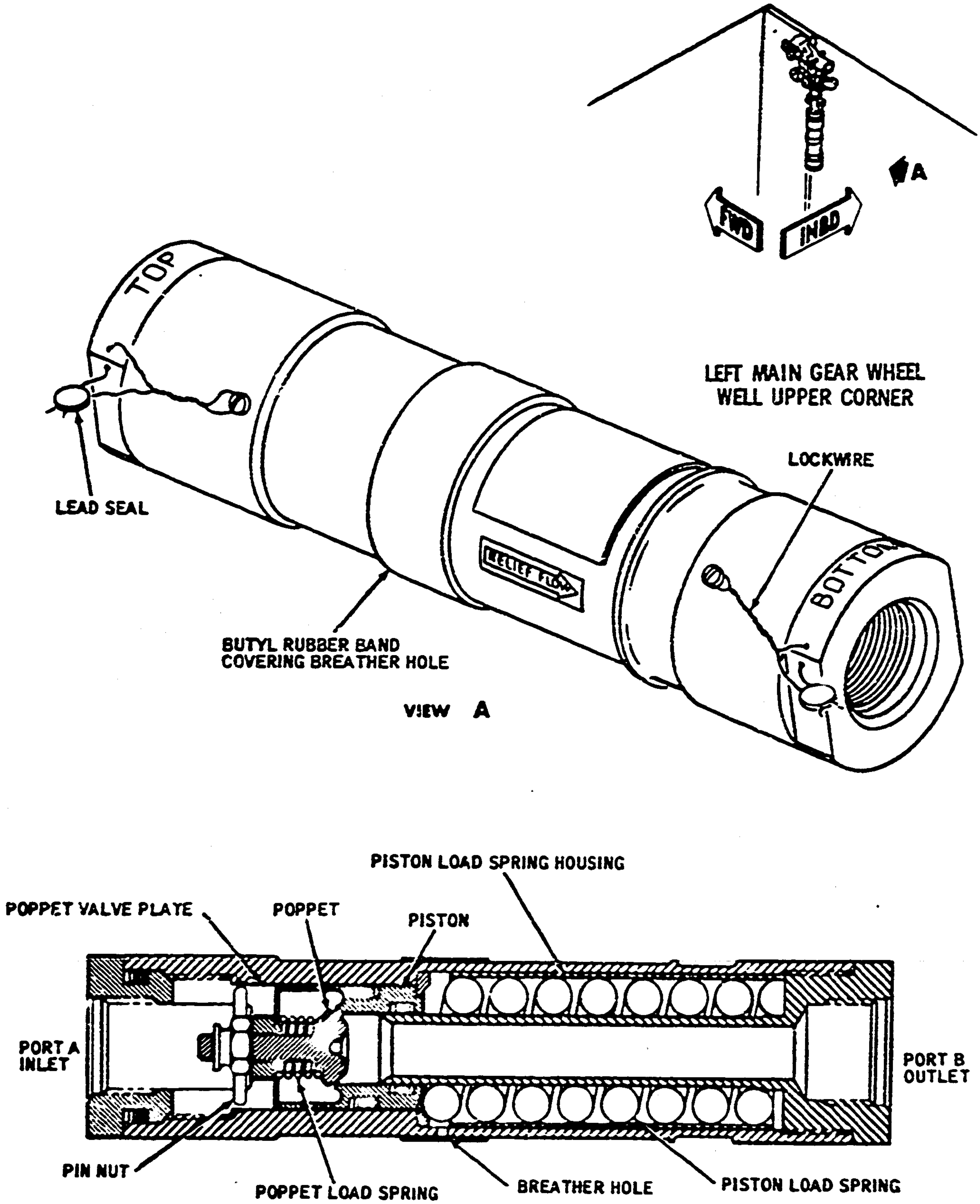
T Hydraulic System Priority Valve (See Figure 22.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.



Hydraulic Power System Accumulator --
Cutaway View
Figure 21



Hydraulic System Priority Valve -- Cutaway View
Figure 22

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10-12 seconds)

(b) Gear extension -- 14 gpm (10-12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Manual Shutoff Valve (Airplanes With S/B 29-67, See Figure 23)

(1) Two manually operated shutoff valves are provided just downstream of the priority valve for isolation of non-priority subsystems during maintenance operations. One valve shuts off pressure to the following subsystems:

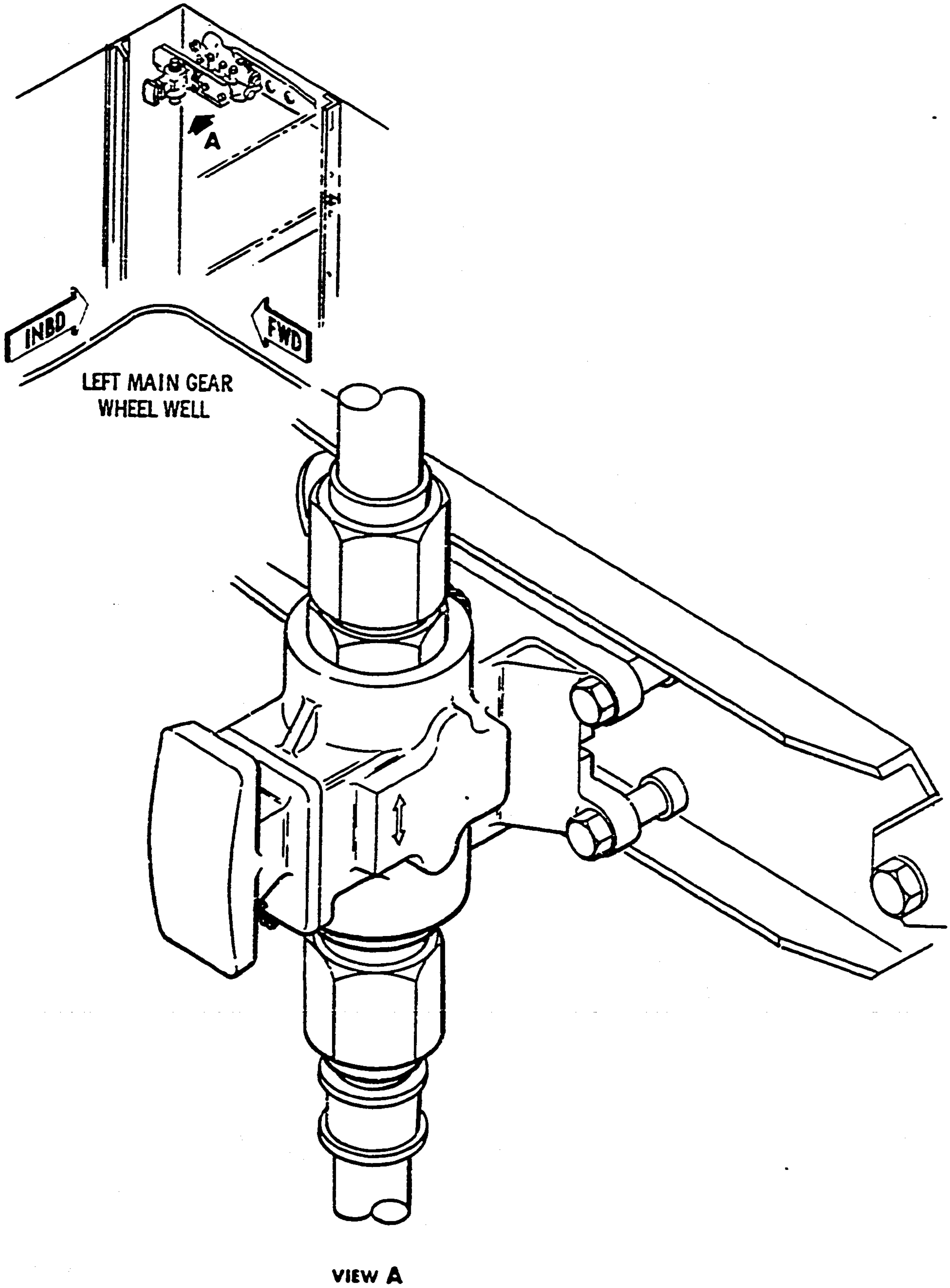
(a) Wing flaps

(b) Wing slots

(c) Main landing gear retraction

(d) Power wheel brakes

(2) The other valve shuts off pressure to the nosegear retraction and nosewheel steering subsystems.



Manual Shutoff Valve
Figure 23

(3) The manual shutoff valves are located in the upper inboard forward corner of the left main gear wheel well. One valve is mounted on the left power manifold support, the other is mounted to a structure stiffener.

(4) The valves consist of two position (on-off), rotary type, valves with identical and interchangeable inlet and outlet ports. A T shaped handle is provided on each valve for manual operation and lockwire holes are provided in the base of the handle for safetying the valve in the open position.

V. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position; supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

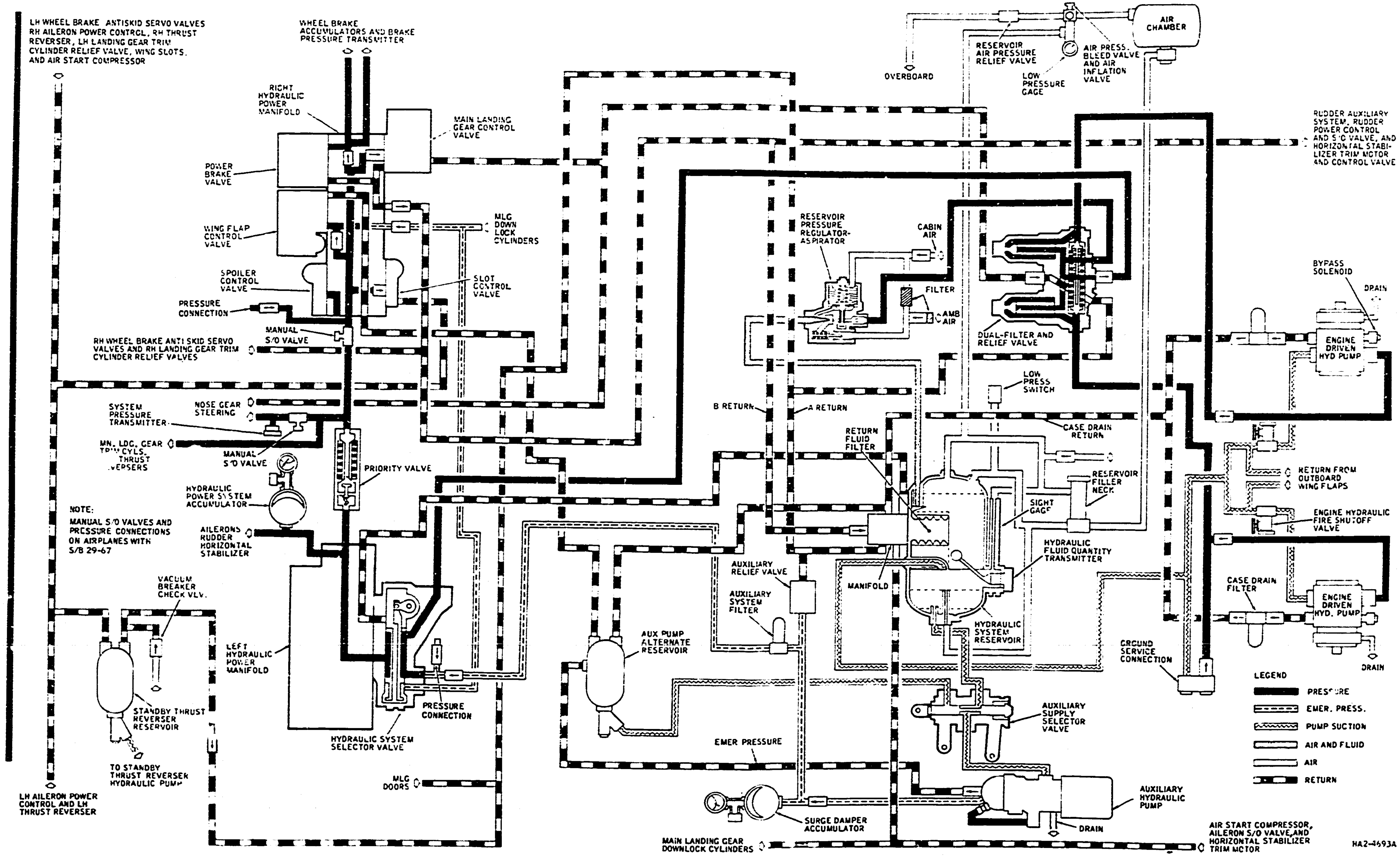
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

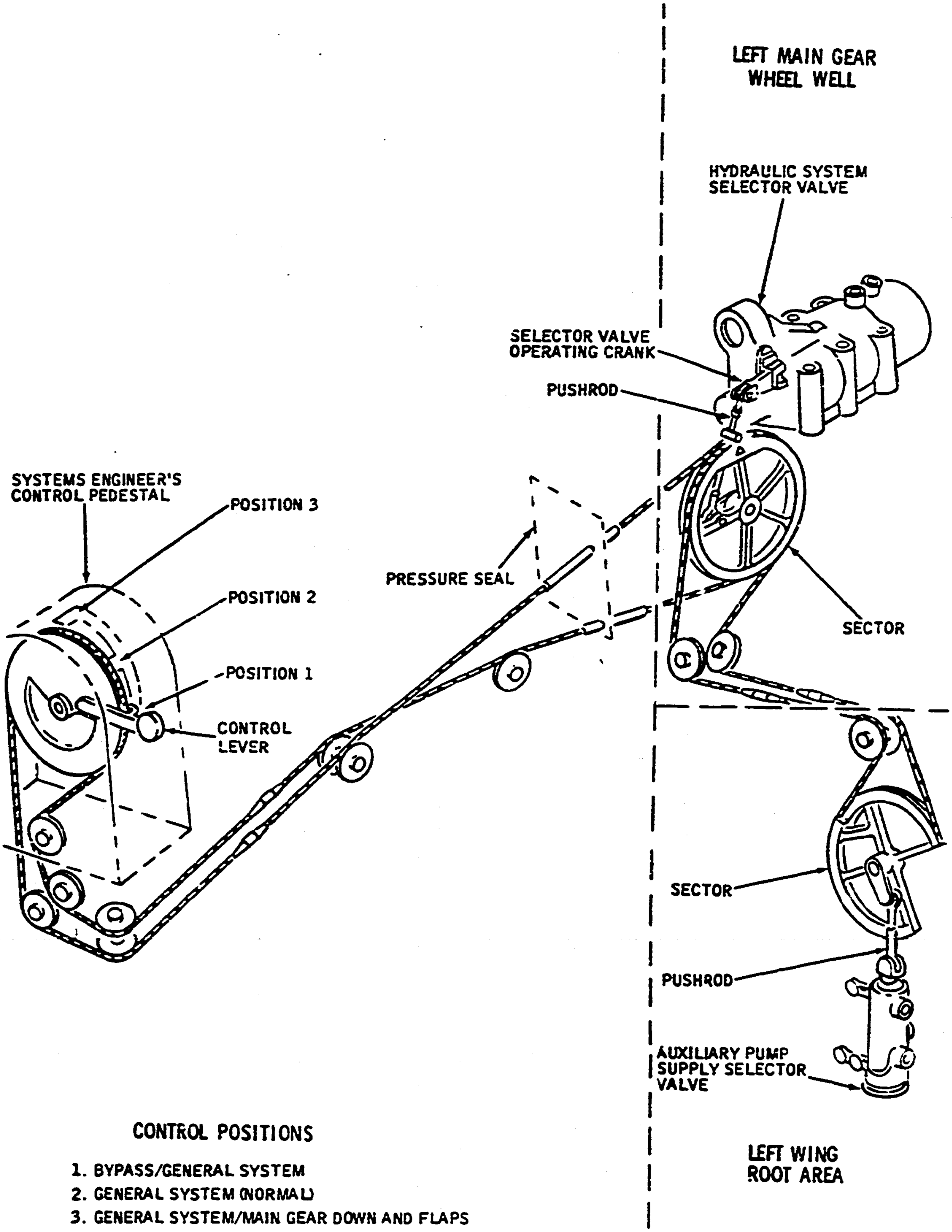
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and colling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid



Hydraulic Power System -- Schematic Diagram
Figure 1



CONTROL POSITIONS

1. BYPASS/GENERAL SYSTEM
2. GENERAL SYSTEM (NORMAL)
3. GENERAL SYSTEM/MAIN GEAR DOWN AND FLAPS

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Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

back to the reservoir via a return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

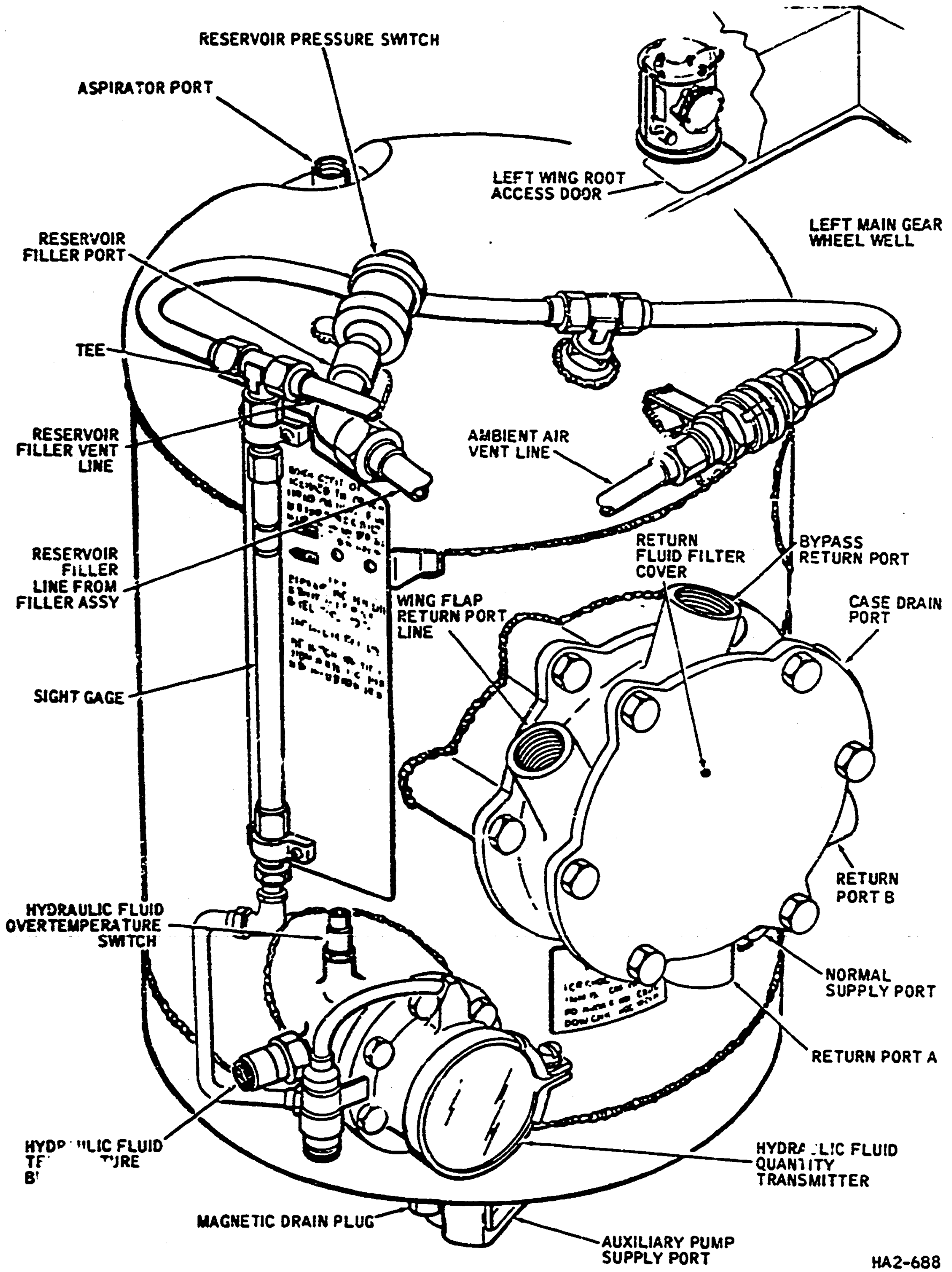
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the



Hydraulic System Reservoir -- External View

Figure 3

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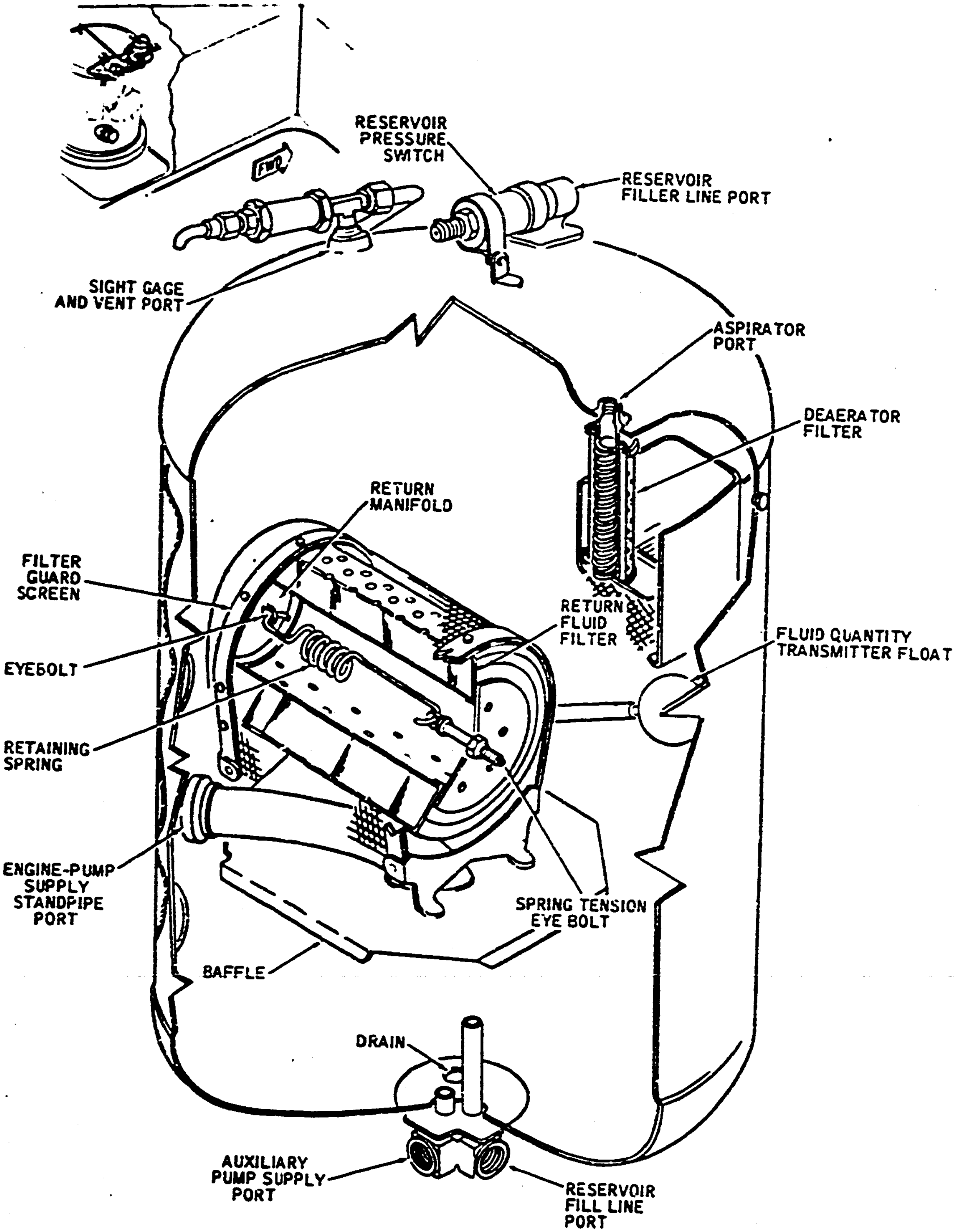


Hydraulic System Reservoir -- Cutaway View
Figure 4

filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

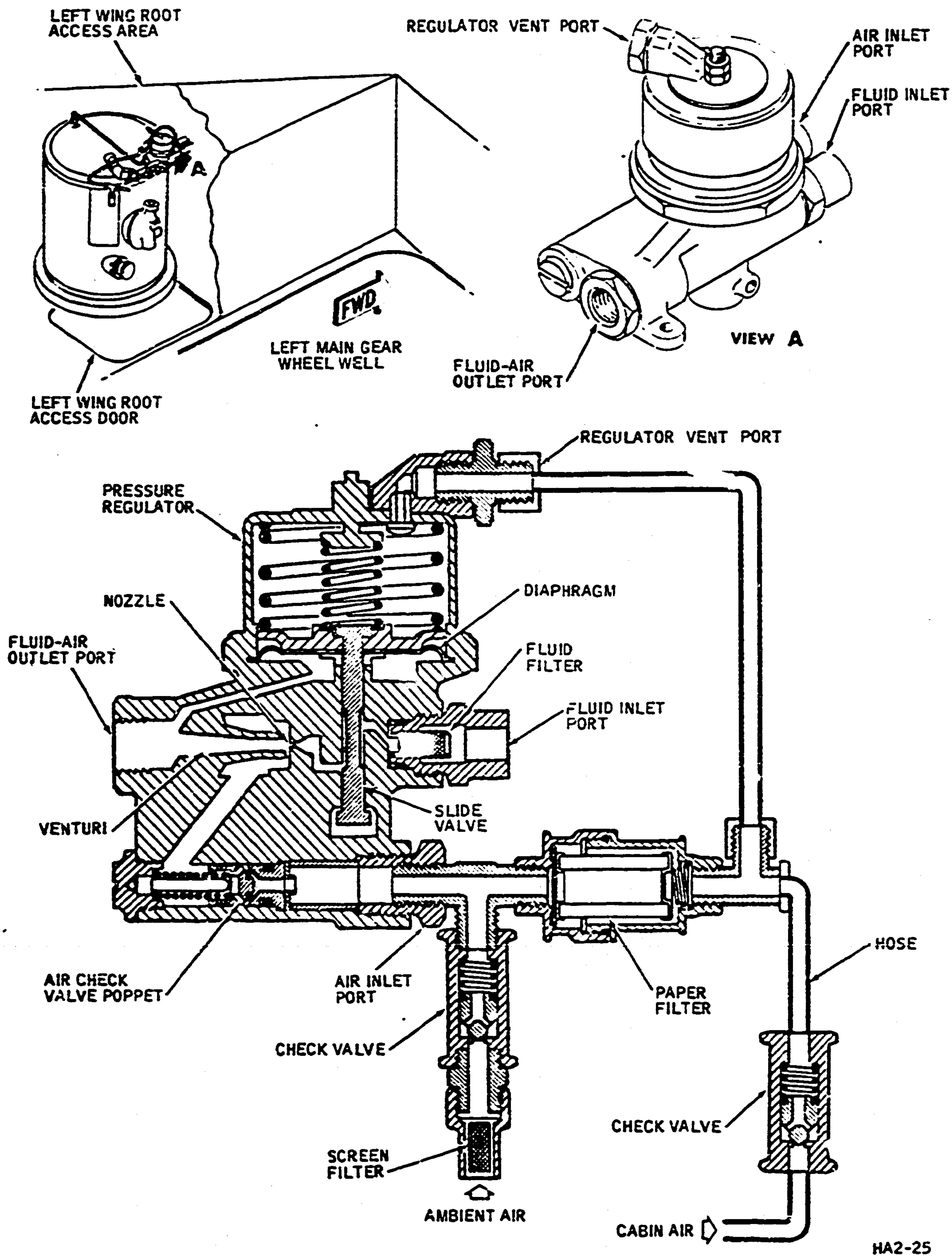
(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The sping passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

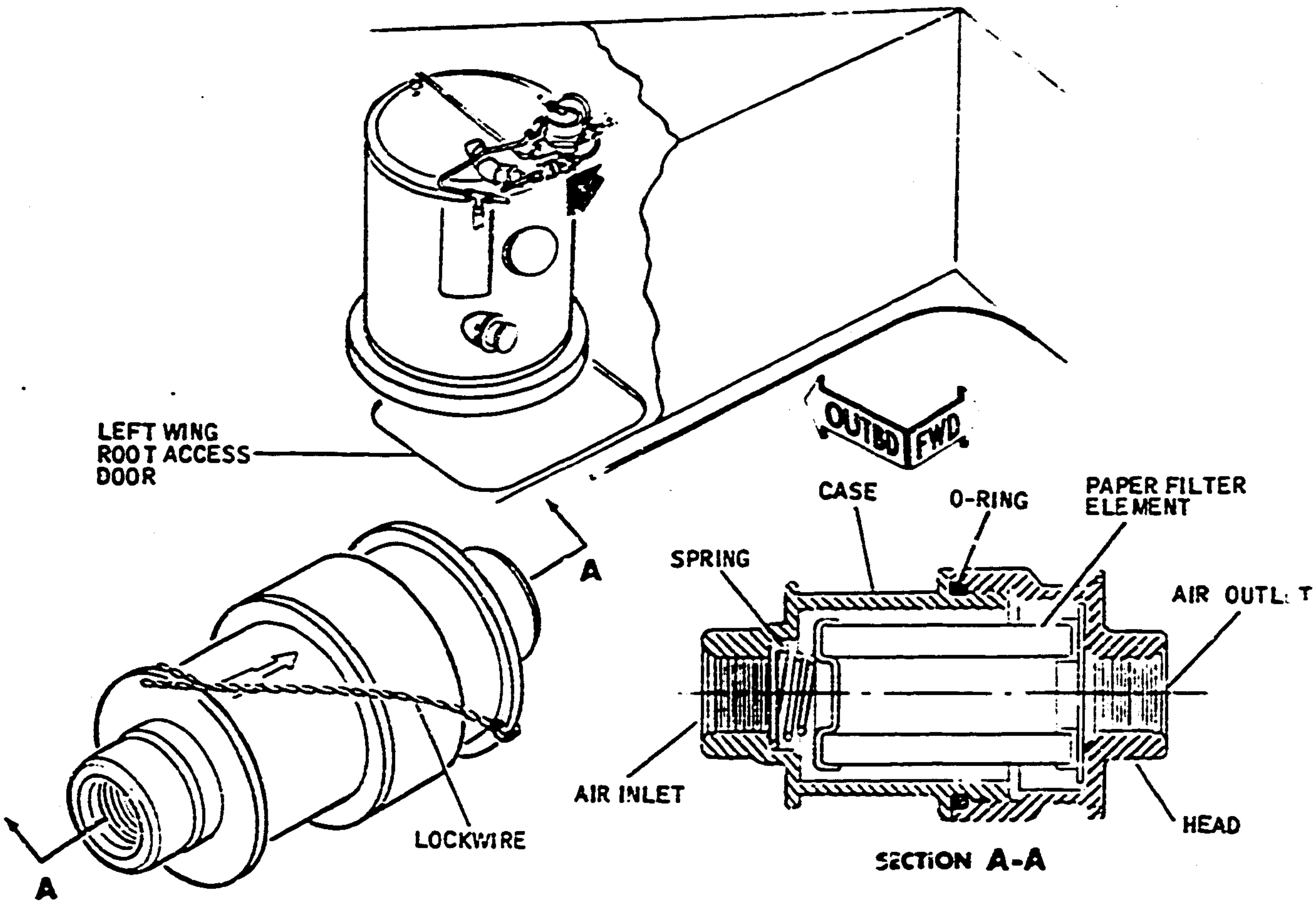
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, The aspirator stalls when outlet pressure reaches a maximum of 40 psi.

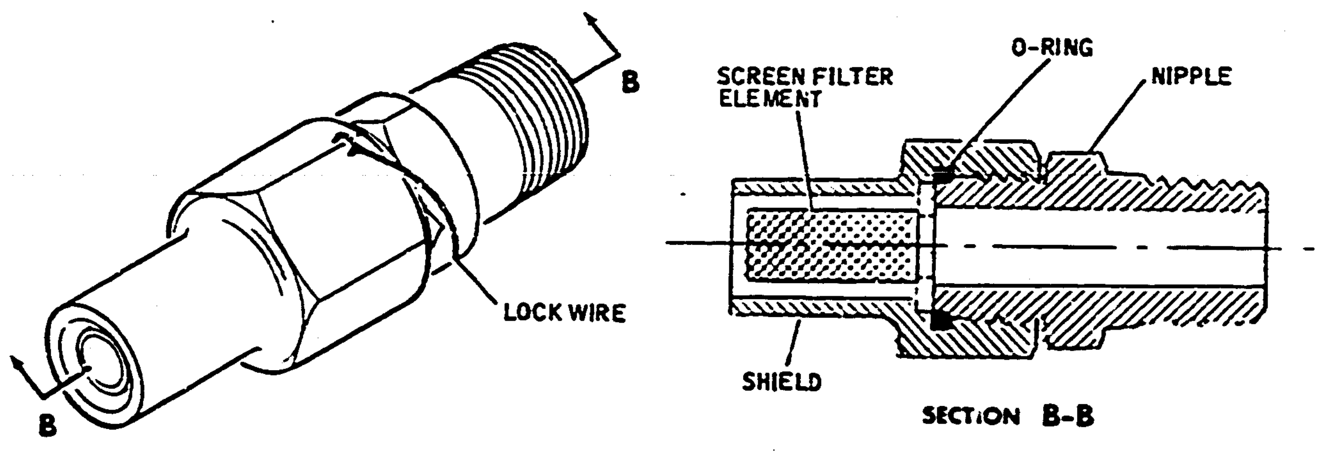
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters, one of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.



PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

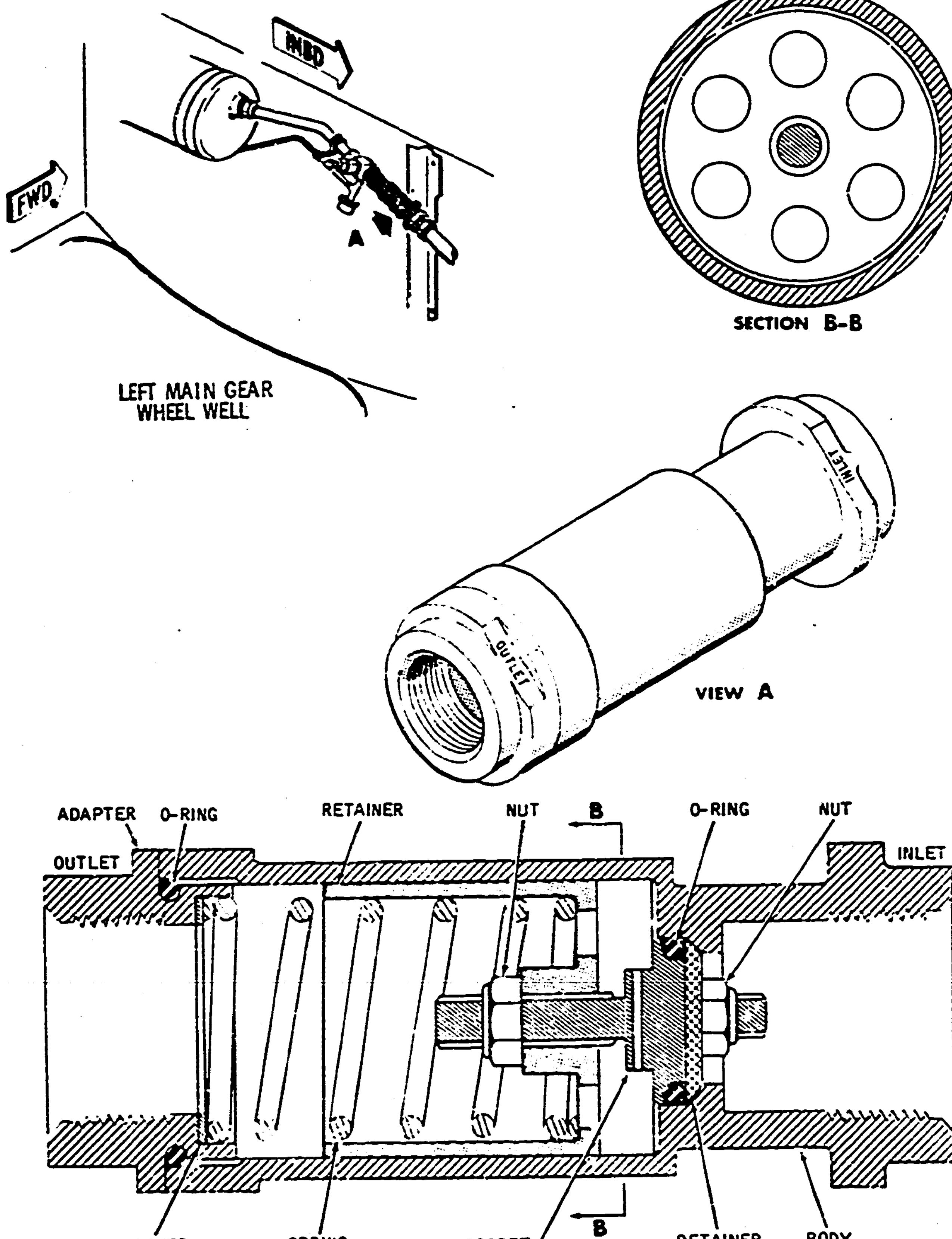
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber



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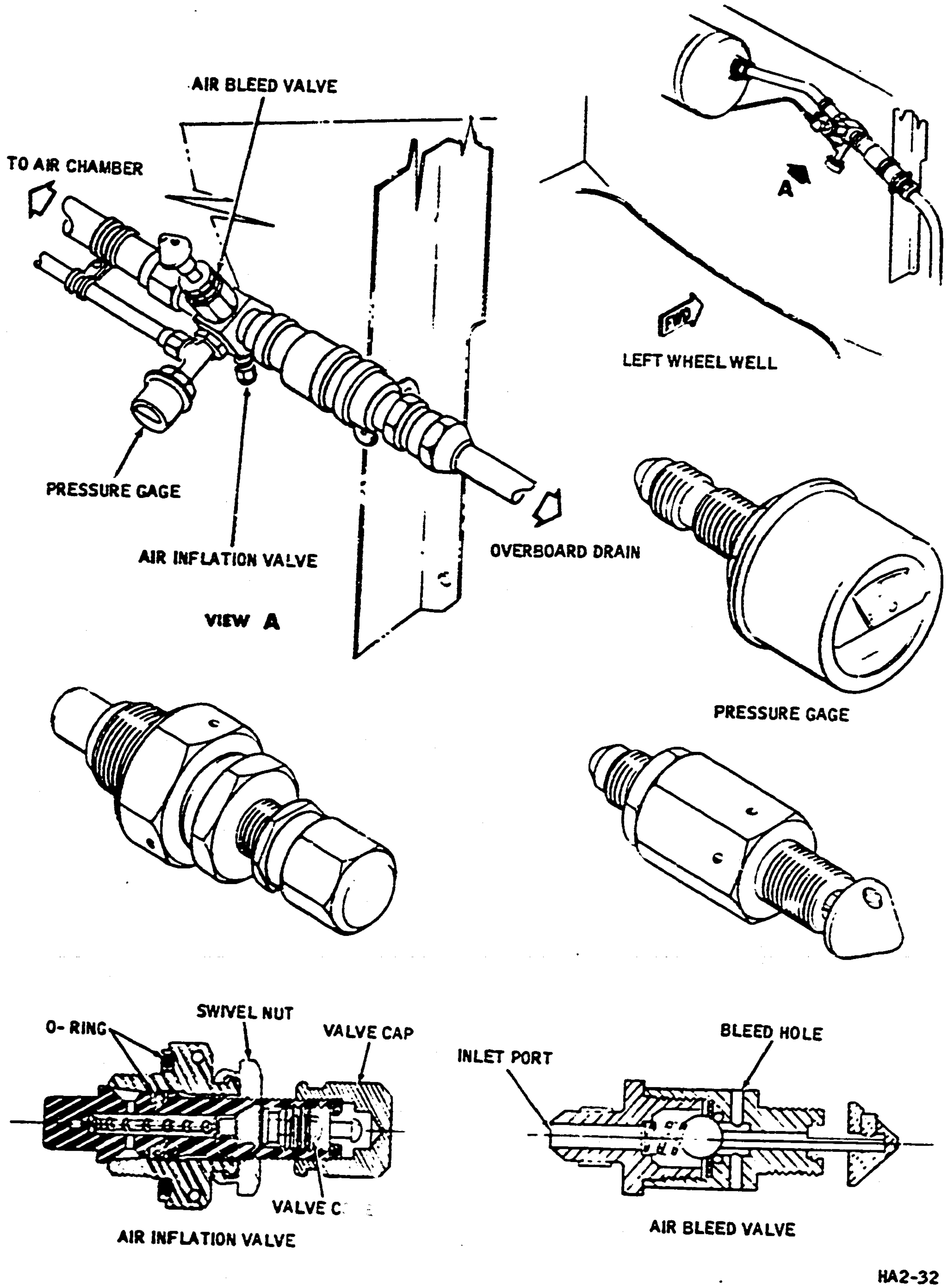
Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage
Figure 8

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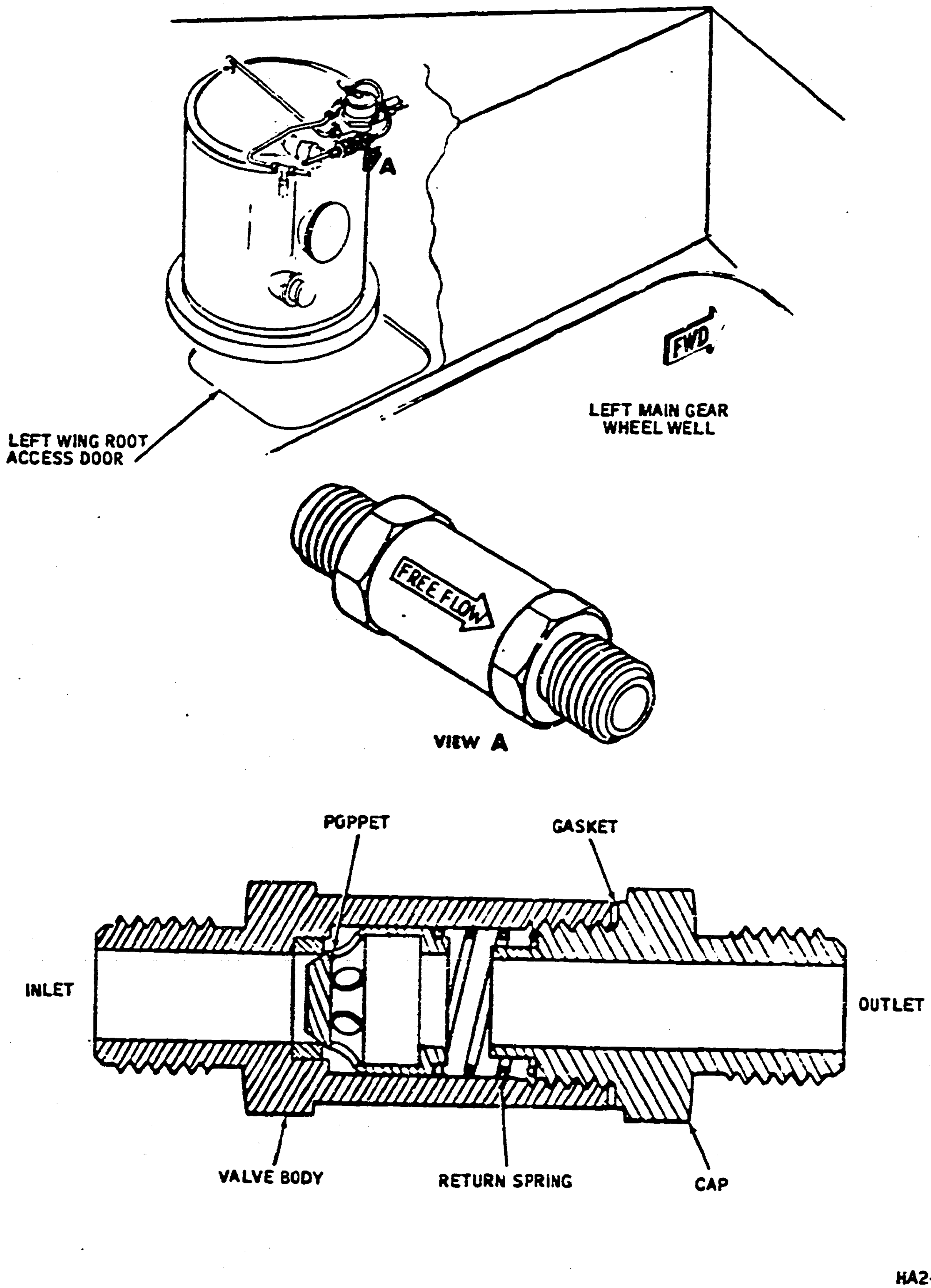


Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

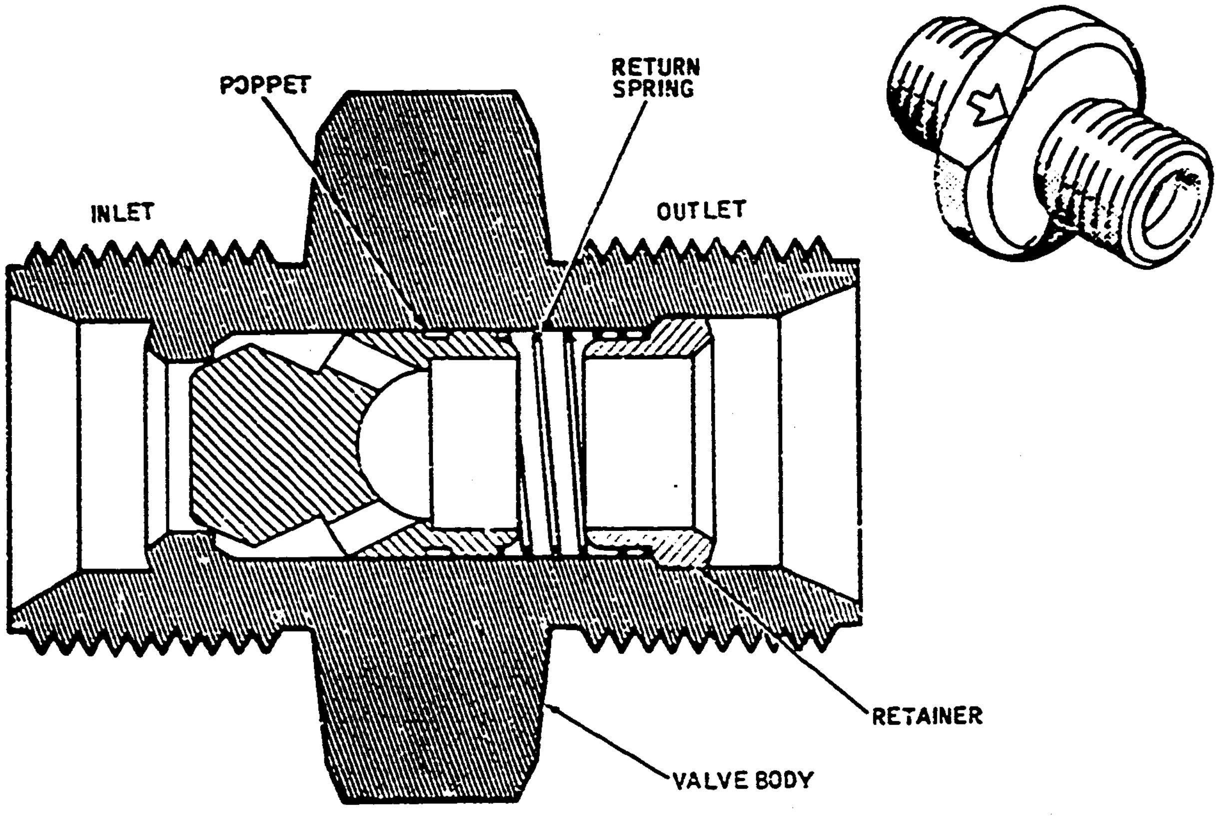
(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

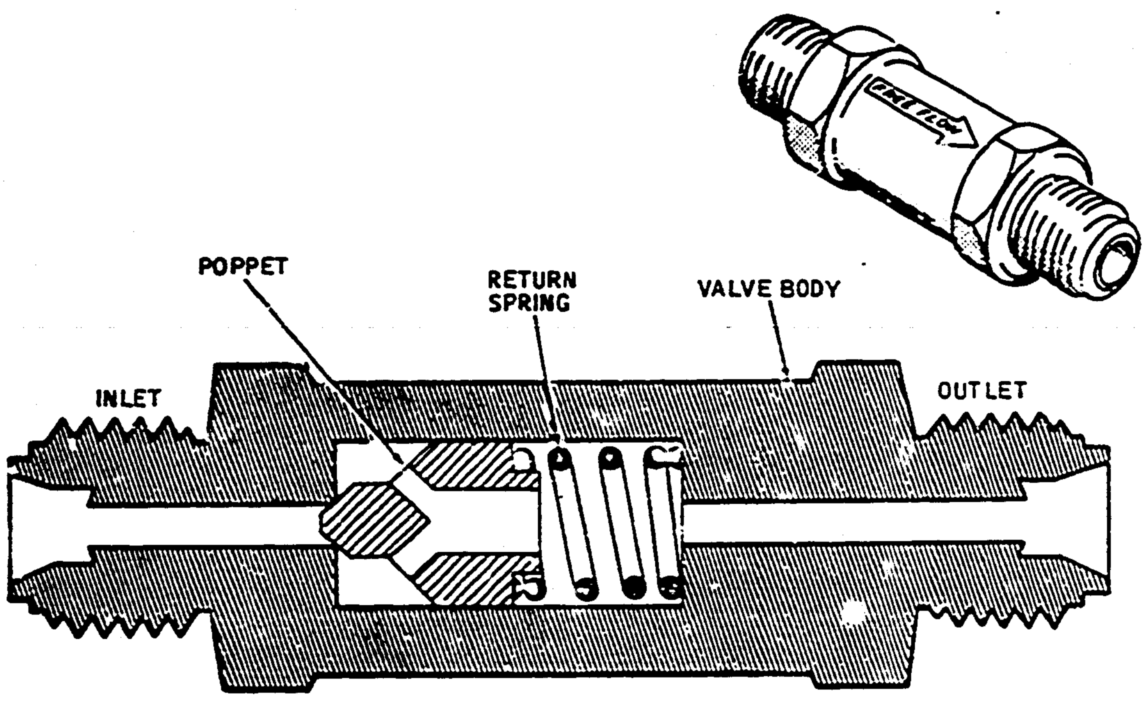
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.



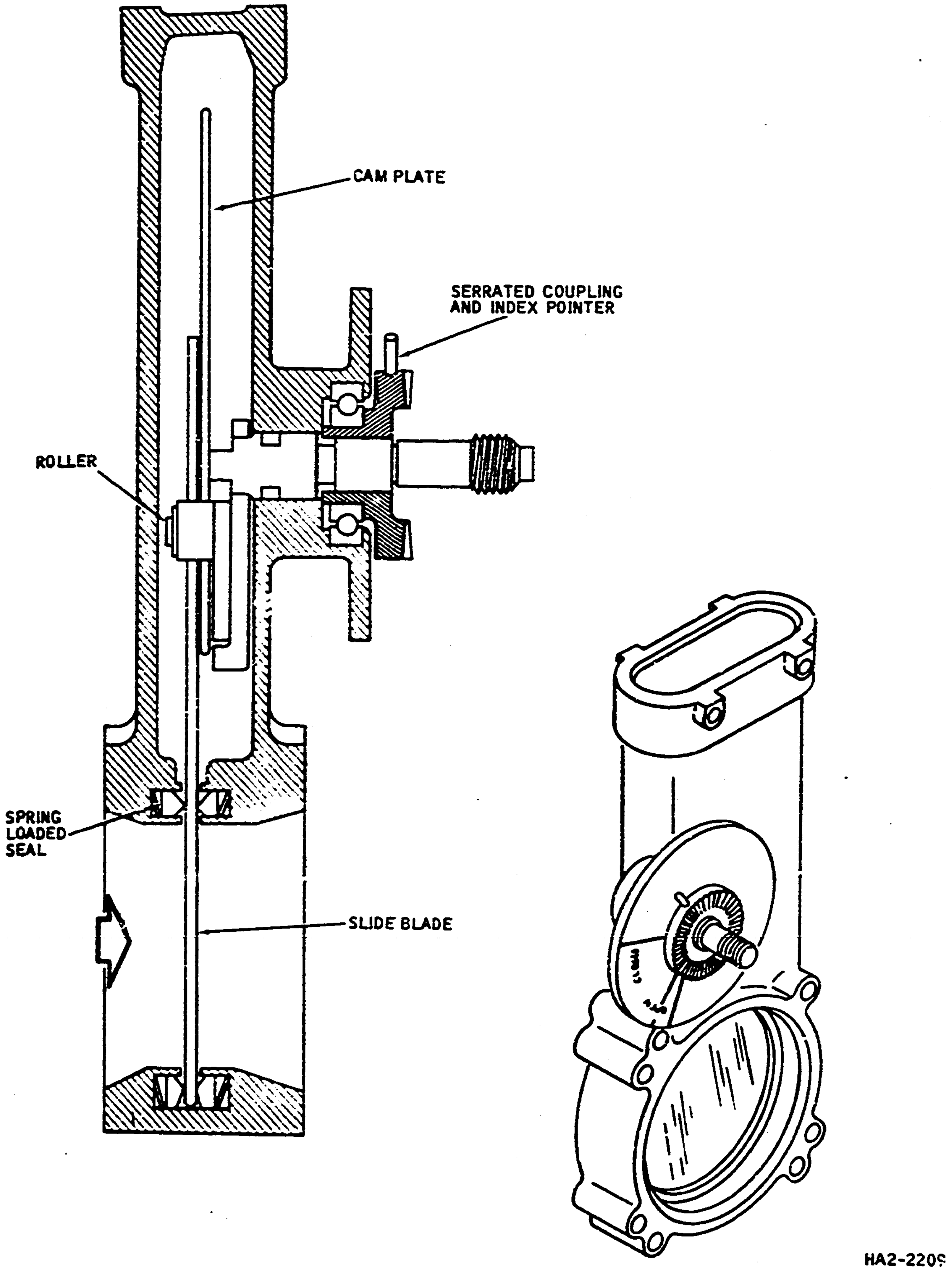
MINIATURE CHECK VALVE



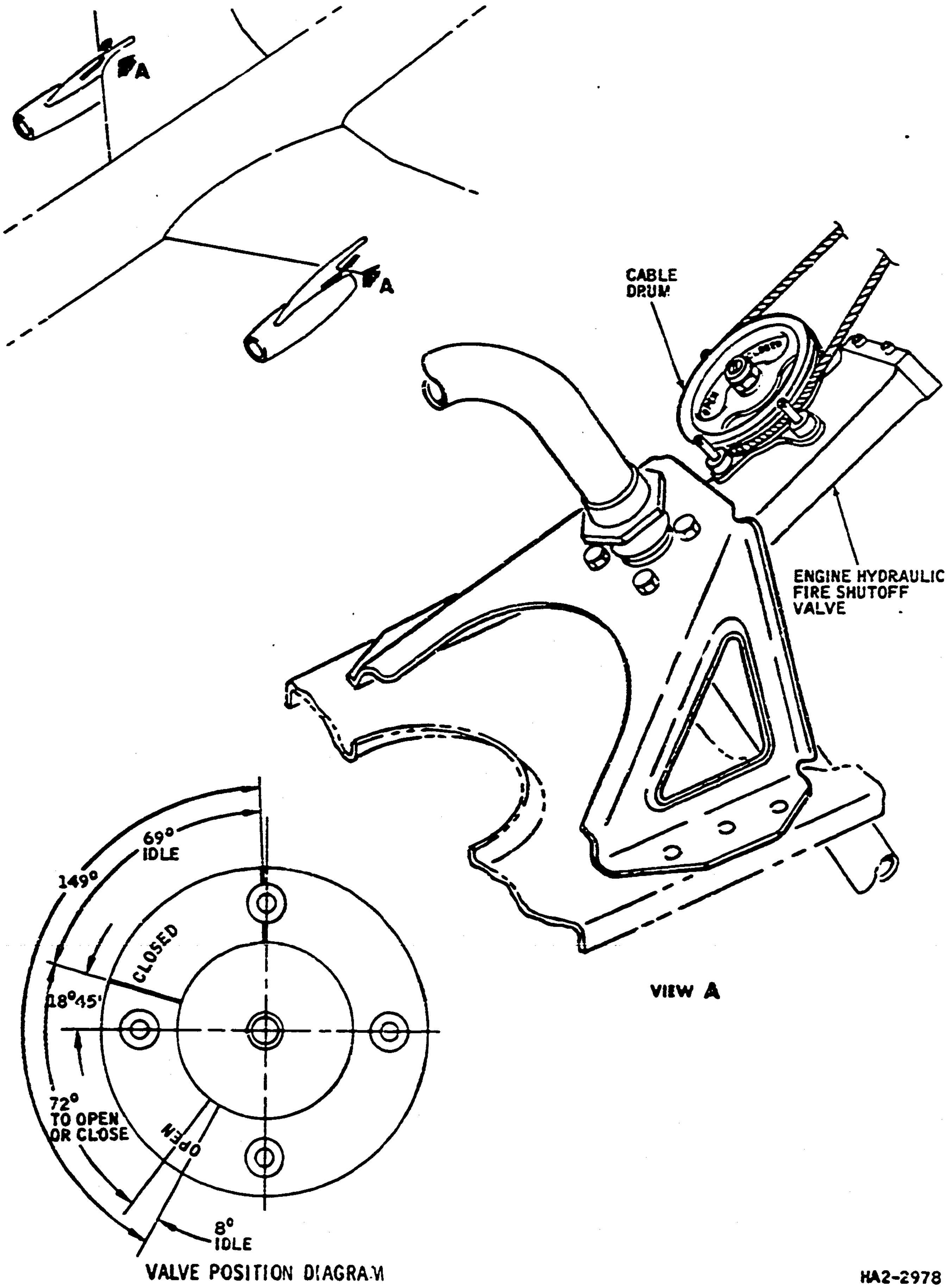
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

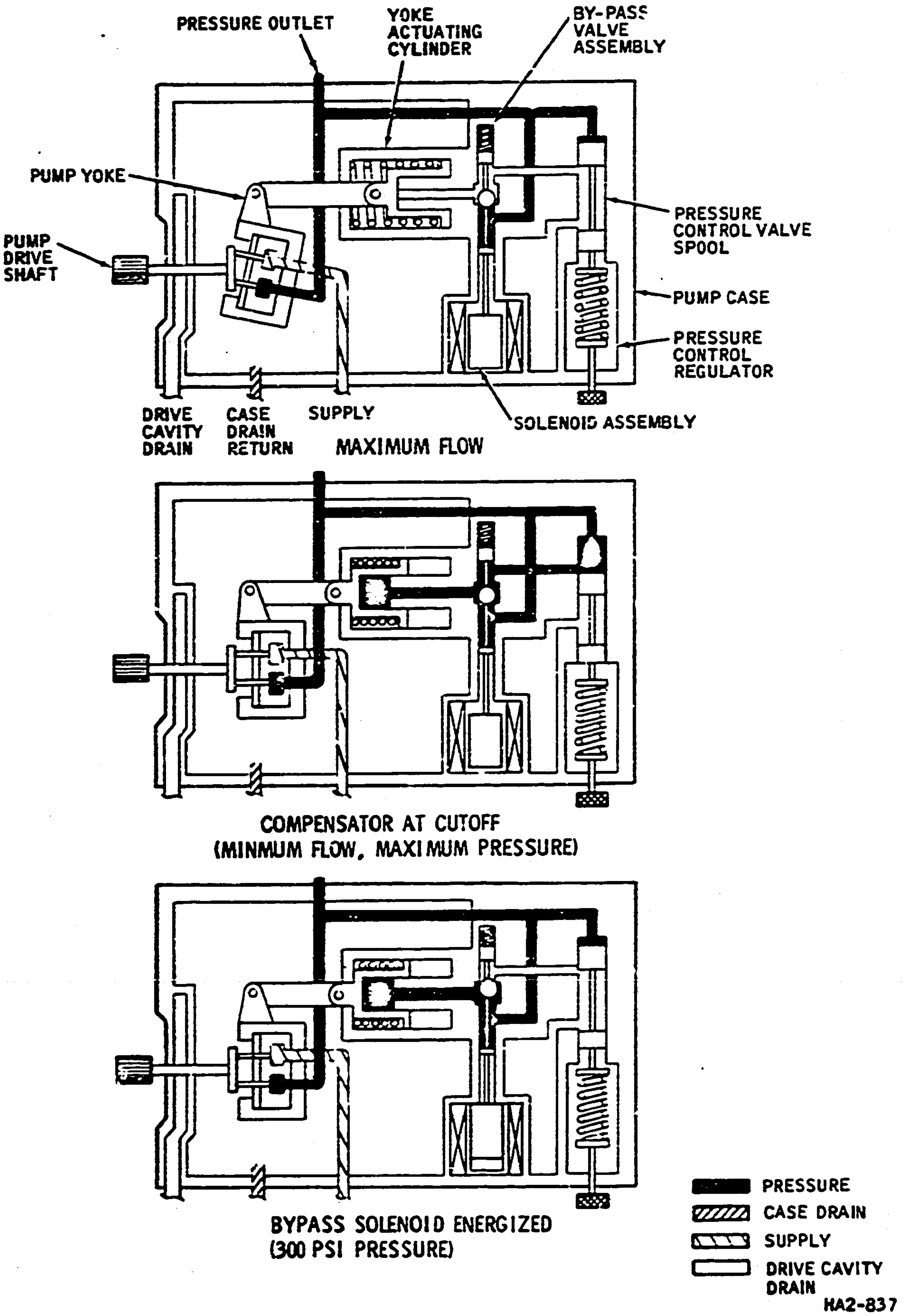
(4) A roller attached to the end of the link rides in, and extends through, A J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (Airplanes N4907C and N4908C, See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulators meter the pressure to the yoke control piston, which positions the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump pressure stabilizes in accordance with system demand.

K1. Engine-Driven Hydraulic Pump (Airplanes N4909C and Subsequent, See Figures 13A and 13B.)

(1) The two, single-stage, variable-displacement, cam-actuated, pressure-compensated, engine-driven hydraulic pumps are installed, one each, on the inboard engines. The pump incorporates a solenoid-operated bypass feature for reducing the output pressure to zero psi. Each bypass valve solenoid is controlled by a corresponding engine hydraulic pump control switch in the flight compartment. The switch for the hydraulic pump on engine 2 is placarded left, on, and bypass. The switch for engine 3 is placarded right, on, and bypass. When a switch is placed in the bypass

position, the bypass valve for that pump is actuated and the pump pressure is reduced to zero psi. When the switch is placed in the on position, the bypass valve is open and the pump operates normally in a pressure range of 2850 to 3050 psi. The pump provides a continuous, nonpulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system.

(2) The heart of the pump is a revolving cylinder barrel which contains nine pistons. By means of a hold-down plate and hydraulically balanced shoes, the pistons are supported on an inclined cam plate which causes them to reciprocate as the barrel revolves. The hold-down plate ensures positive stroking of the pistons during the suction stroke. The angle of the cam plate is varied by moving the trunnioned hanger on which it is mounted, thereby changing the displacement of the pump. The hanger, in turn, is controlled by a pressure compensator.

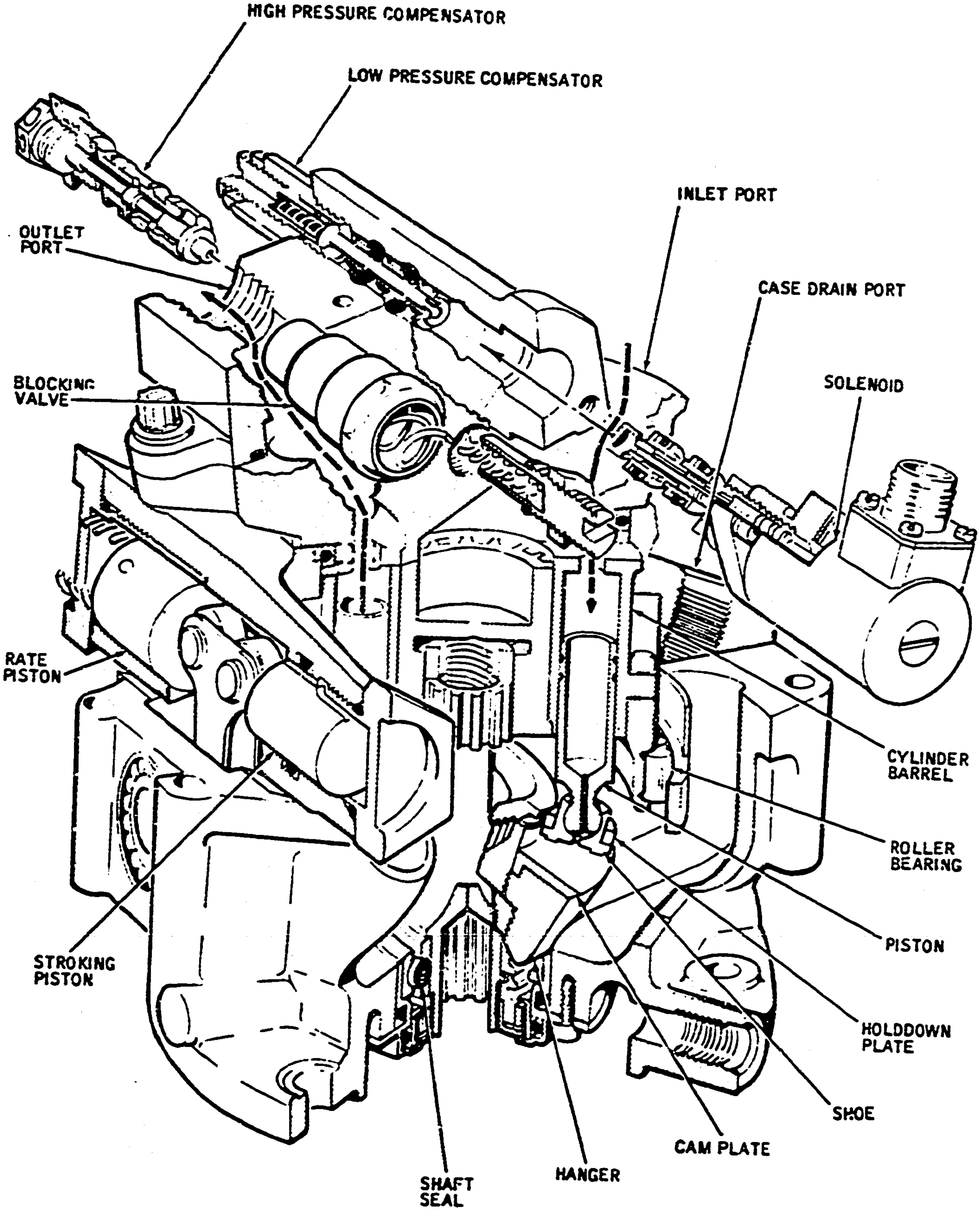
(3) Oil passes through the main inlet and then through porting in the end of the cylinder barrel to the cylinders from which the pistons are being withdrawn. As the cylinder barrel revolves, these pistons are forced into their bores and discharge high-pressure oil through porting in the end of the barrel to the outlet port.

(4) The cylinder barrel, supported by a radial bearing, is driven by an internal shaft which passes through the trunnioned hanger. A hydraulically balanced, face-type, carbon shaft seal is used to assure optimum sealing. Sealing pressure increases as case pressure increases, and the seal adjusts itself to compensate for any wear which takes place.

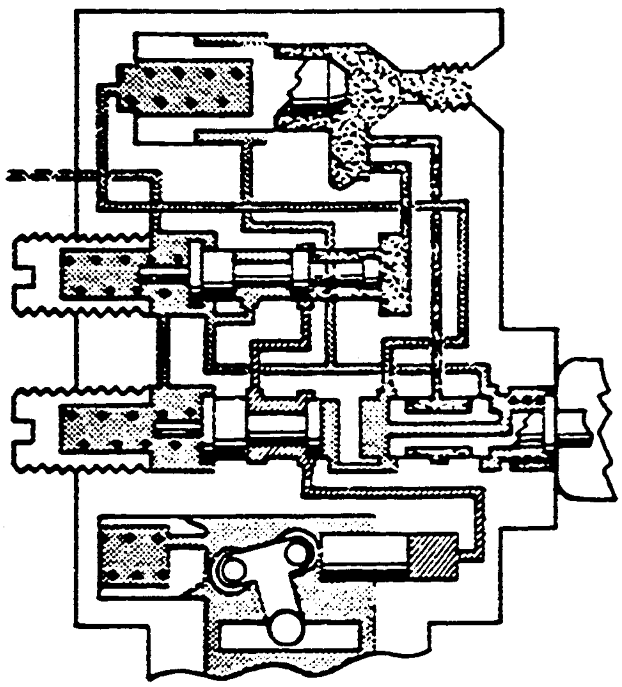
(5) The pressure compensator regulates the volume delivered in accordance with the demand of the system and maintains the predetermined pressure. When the pressure is less than the spring load, the spring moves the spool to vent oil in the stroking cylinder to the case. The stroking piston then retracts and a spring load on the hanger moves it to a greater angle and increases the volume pumped. The axial thrust of the pistons against the cam plate during power stroke is balanced hydraulically. Oil, at system pressure, is admitted through holes in the piston and shoe to an undercut area in the face of the piston shoe. The pressure applied to the undercut area, which is slightly less than the piston area, effectively balances the forces so that the shoe is supported on an oil film at all times. Balance is controlled to such a degree that there is no excessive leakage, and high volumetric efficiency is maintained.

(6) The axial thrust of the cylinder barrel is also balanced hydraulically against the port plate.

(7) Because of these features, the axial thrust of the pistons is transferred hydraulically, eliminating the need for antifriction thrust bearings. This increases the reliability factor, if contamination or other adverse conditions exist.

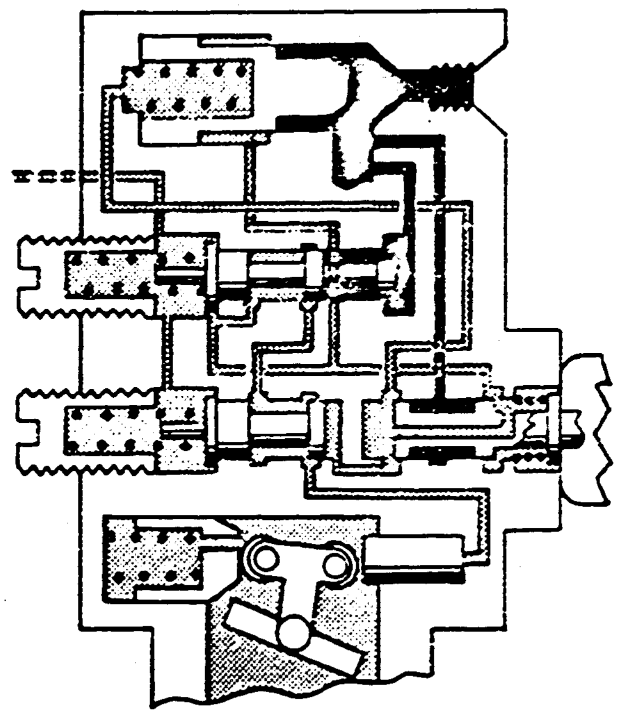


Engine-Driven Hydraulic Pump -- Cutaway View
Figure 13A



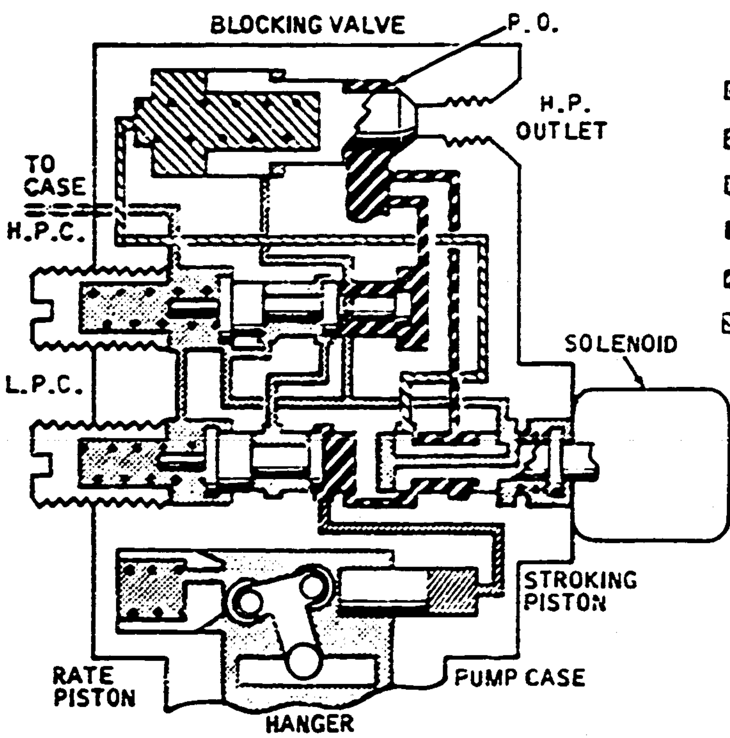
A. FULL PRESSURE, NO FLOW CONDITION

BLOCKING VALVE OPEN, 3,000 PSI FLUID AVAILABLE, NO DEMAND.



B. FULL FLOW CONDITION

BLOCKING VALVE OPEN, HANGER "ON STROKE" 3,000 PSI FLUID FLOWING FROM PUMP.



C. DEPRESSURIZED AND BLOCKED CONDITION

SOLENOID ENERGIZED, BLOCKING VALVE CLOSED, PUMP COMPENSATED AT 500 PSI.

KEY

- COMPENSATED PRESSURE: 3,000 ± 50
- CONTROL PRESSURE: 200-300
- CASE PRESSURE: 45-55
- FULL FLOW PRESSURE: TO 2,950
- DEPRESSURIZED PRESSURE: 400-500
- BLOCKING VALVE PRESSURE: 400-500
- P.O. = PUMP OUTLET
- H.P.C. = HIGH PRESSURE COMPENSATOR
- L.P.C. = LOW PRESSURE COMPENSATOR

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Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13B

(8) The pump functions as a standard, pressure-compensated pump, when the bypass solenoid is not energized. Energizing the solenoid allows the pump to compensate at a reduced, controlled pressure of approximately 500 psi. Also incorporated in the cap is a blocking valve. The valve shuts off the discharge flow from the pump, when the 500 psi compensating valve takes over as a result of the solenoid being energized. Hence, depressurizing the pump permits operation with the pump completely feathered at approximately 1/2 drive torque required at 3000 psi. The blocking valve is automatically controlled by the depressurizing valve. When the solenoid is energized, the blocking valve prevents flow from the pump discharge port. When the solenoid is deenergized, the blocking valve automatically opens as the pump builds up pressure to match the system demand.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

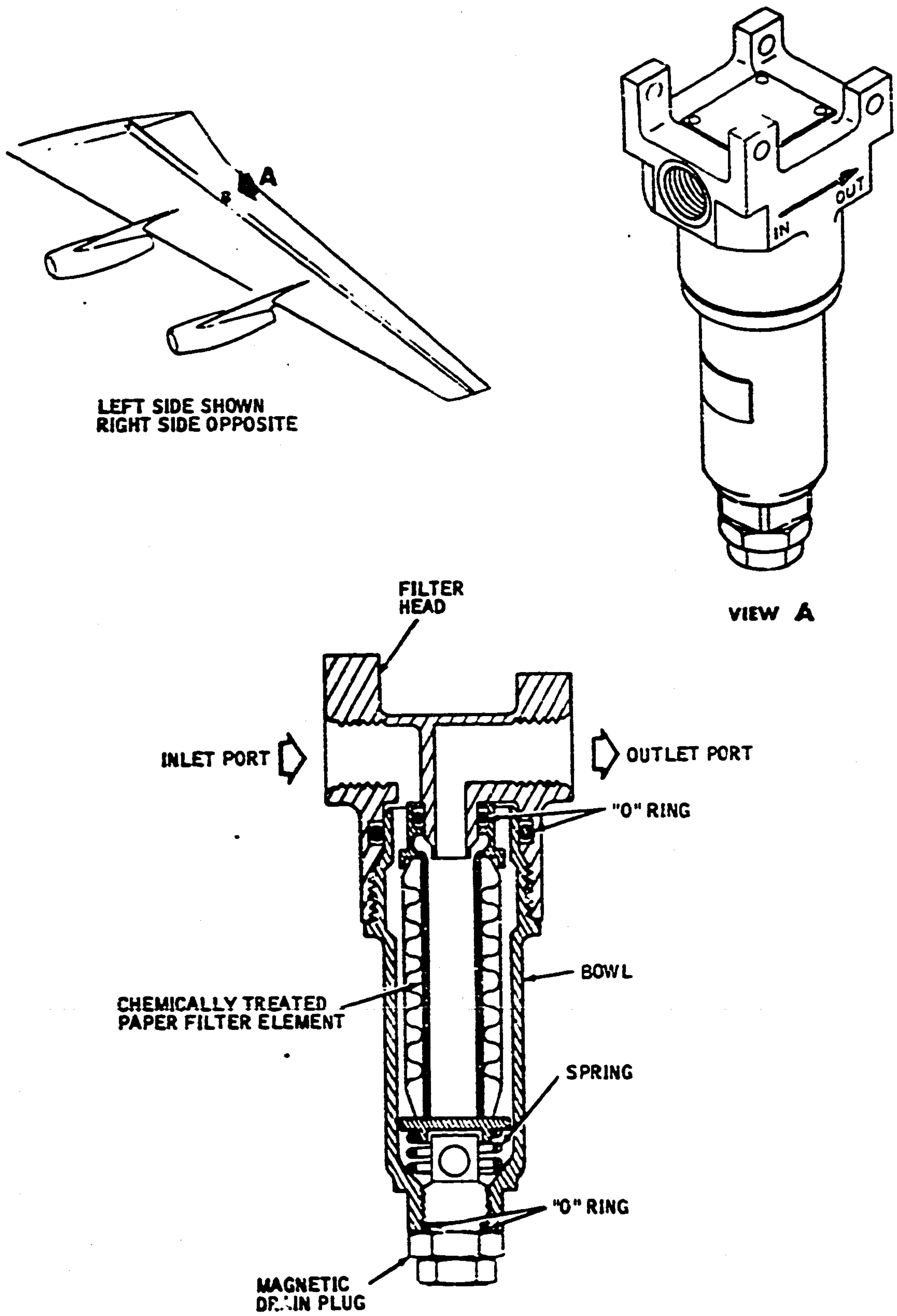
(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.



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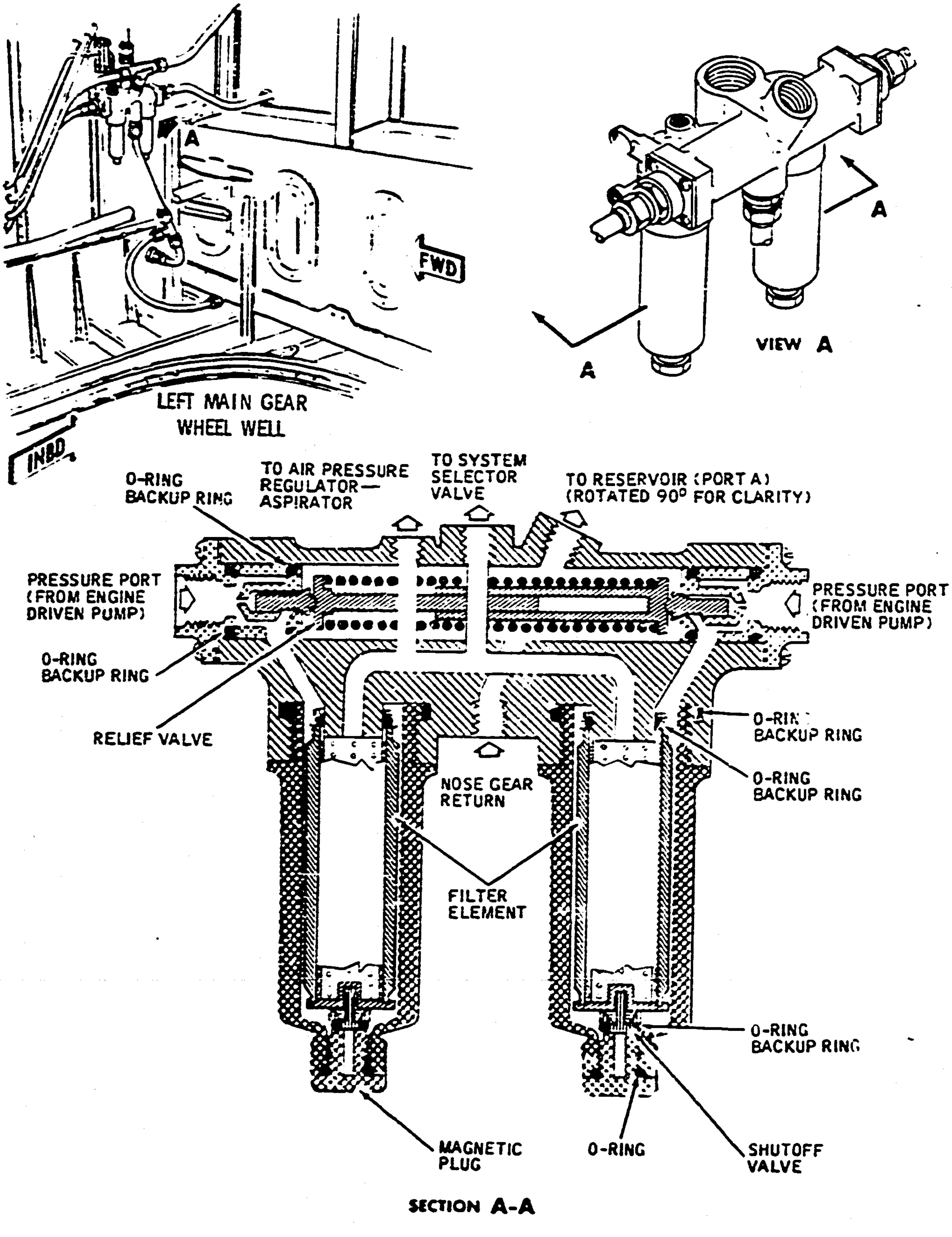
Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



Dual-Filter and Relief Valve -- Cutaway View
Figure 15

(4) If either of the filter elements becomes clogged, pressure above 3000 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow or pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

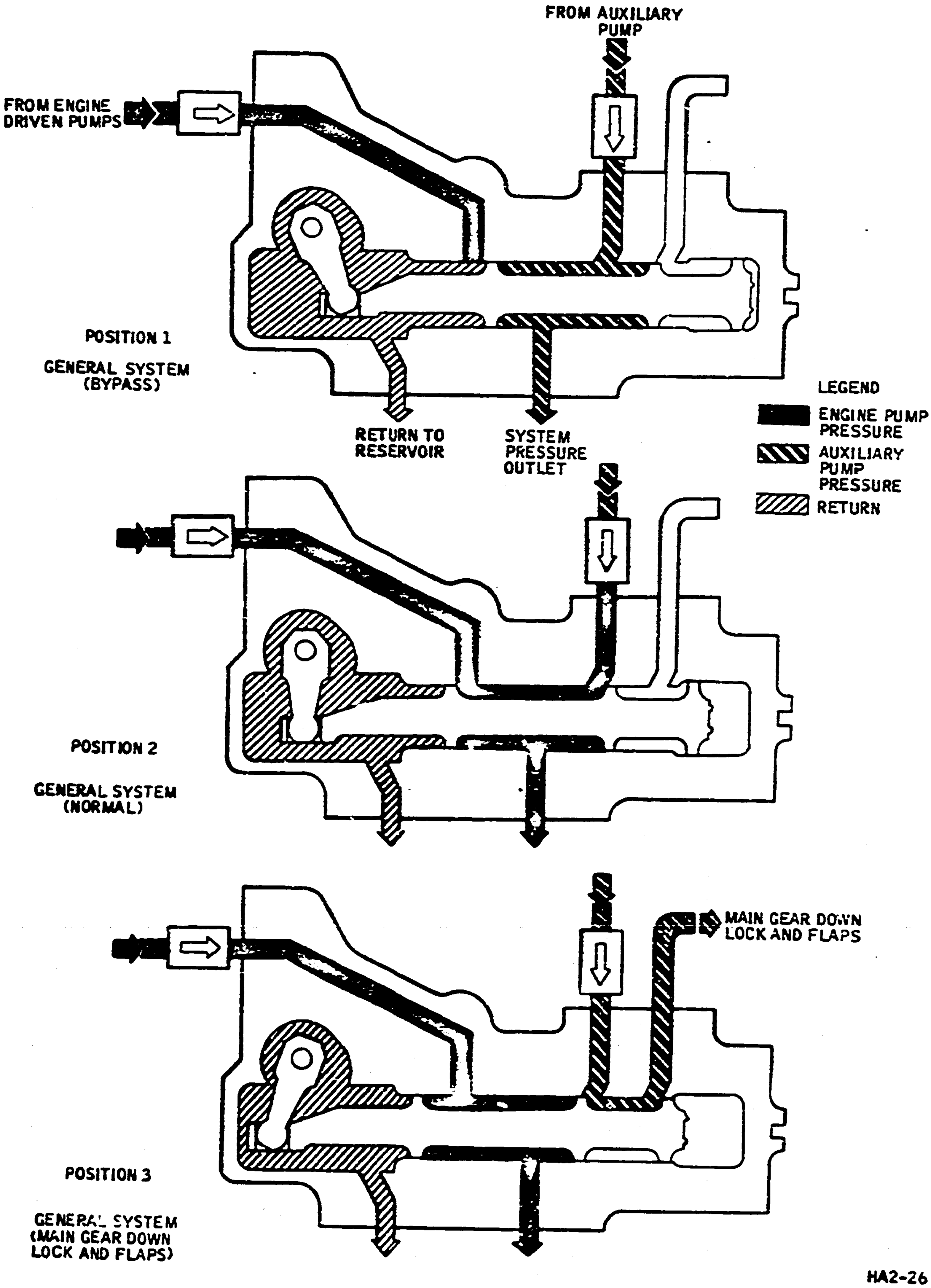
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

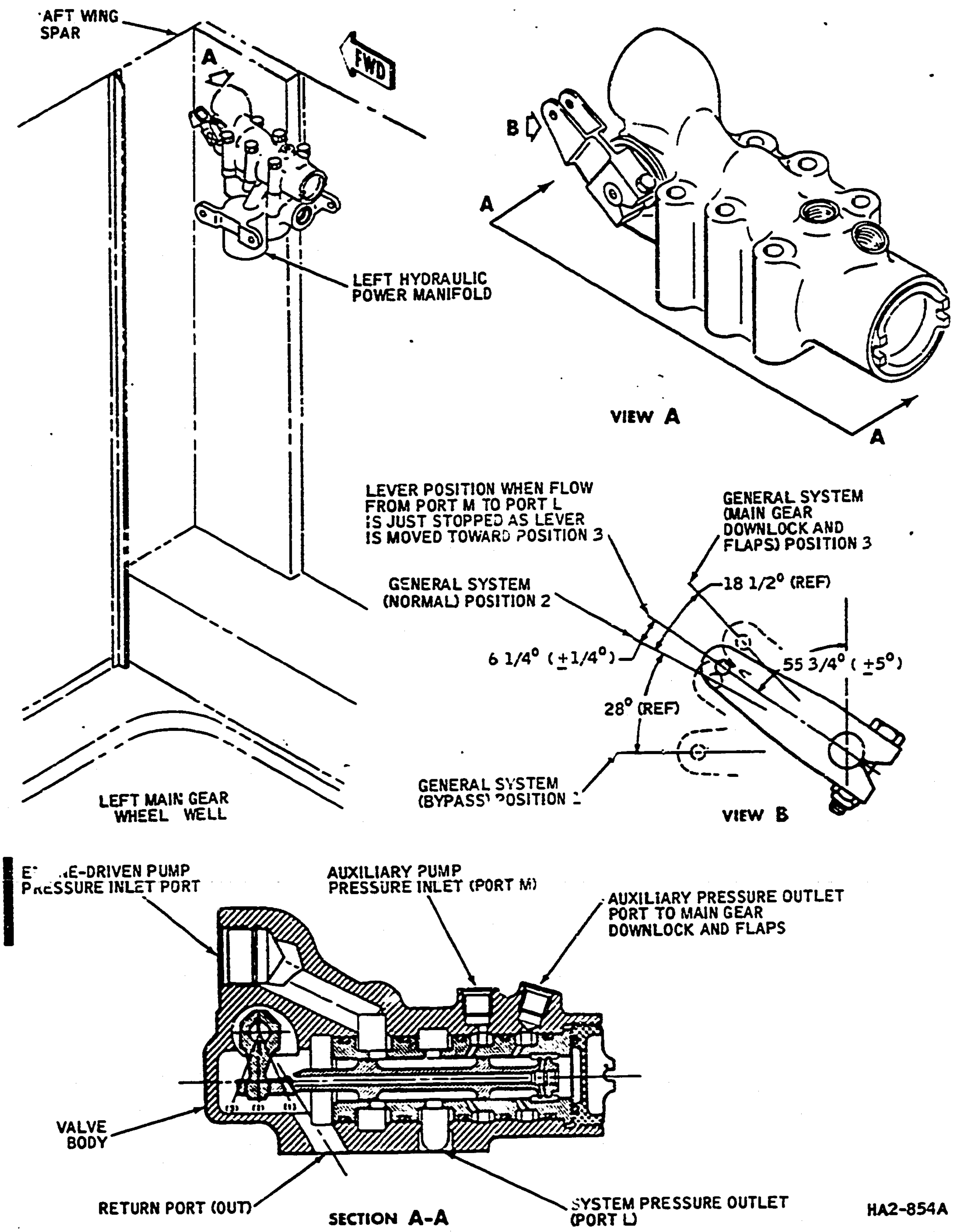
(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, ates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear downlock and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps. Internal leakage provides lubrication for the moving parts of the valve.

P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.



System Selector Valve -- Schematic
Figure 16



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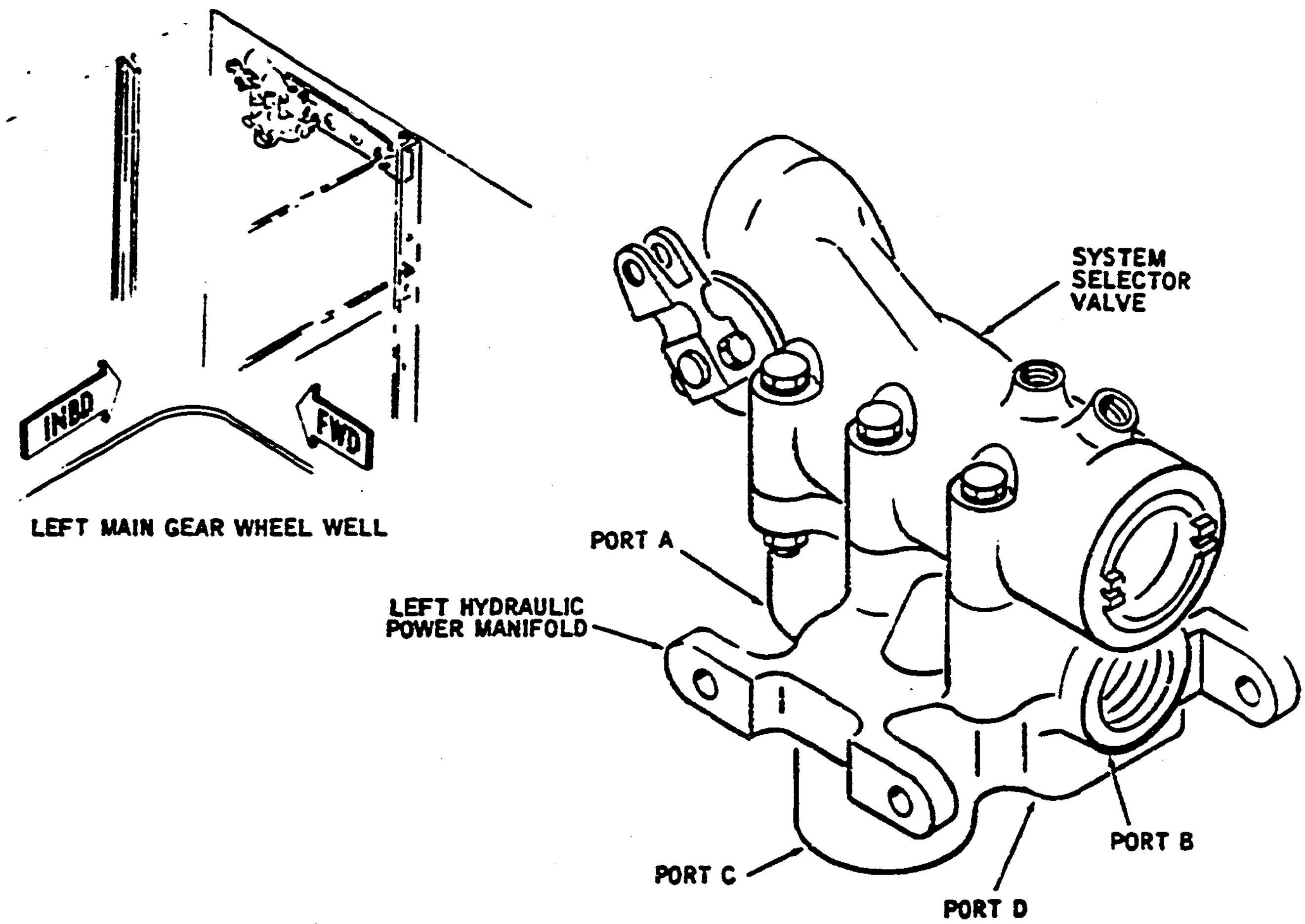
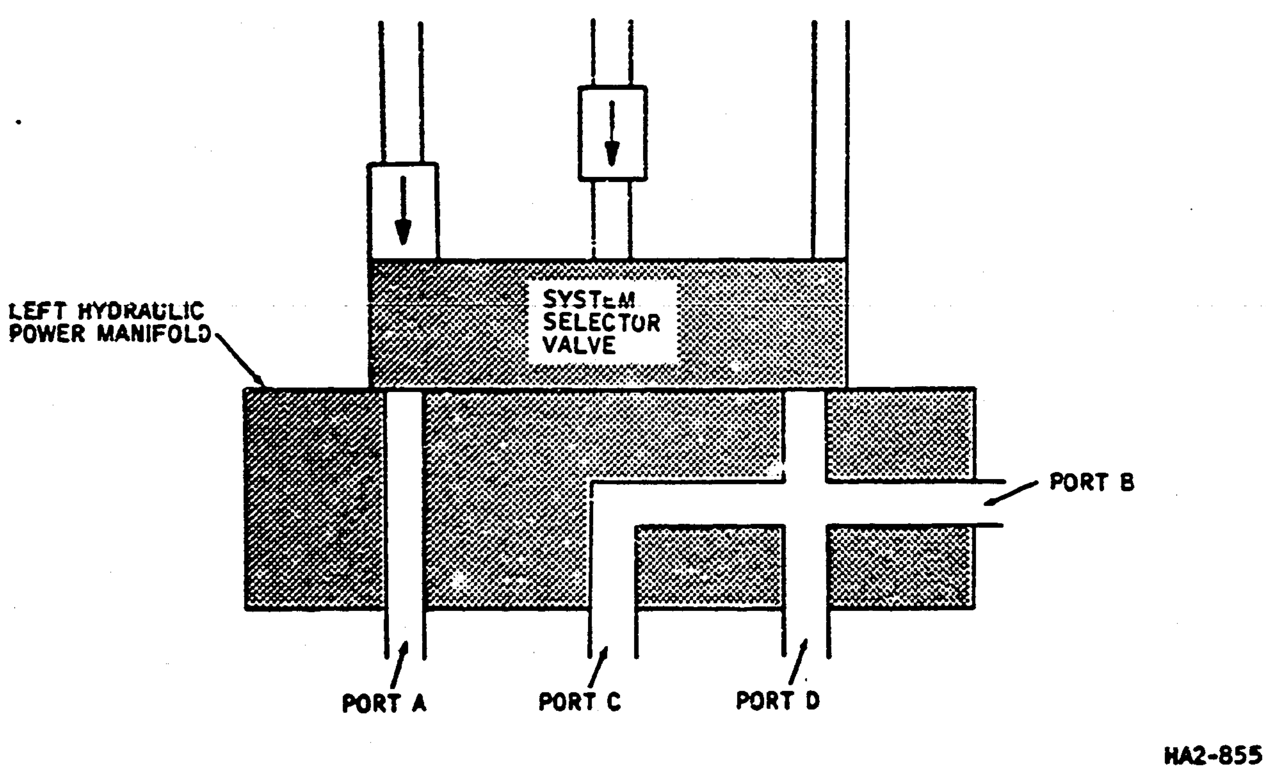
System Selector Valve -- Cutaway View
Figure 17





Left Hydraulic Power Manifold -- Schematic
Figure 18

(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

Q. Right Hydraulic Power Manifold (See Figure 19.)

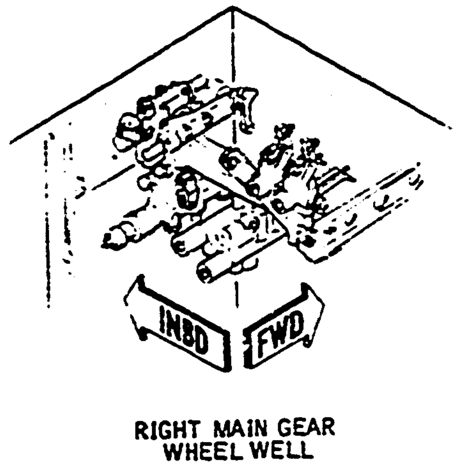
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

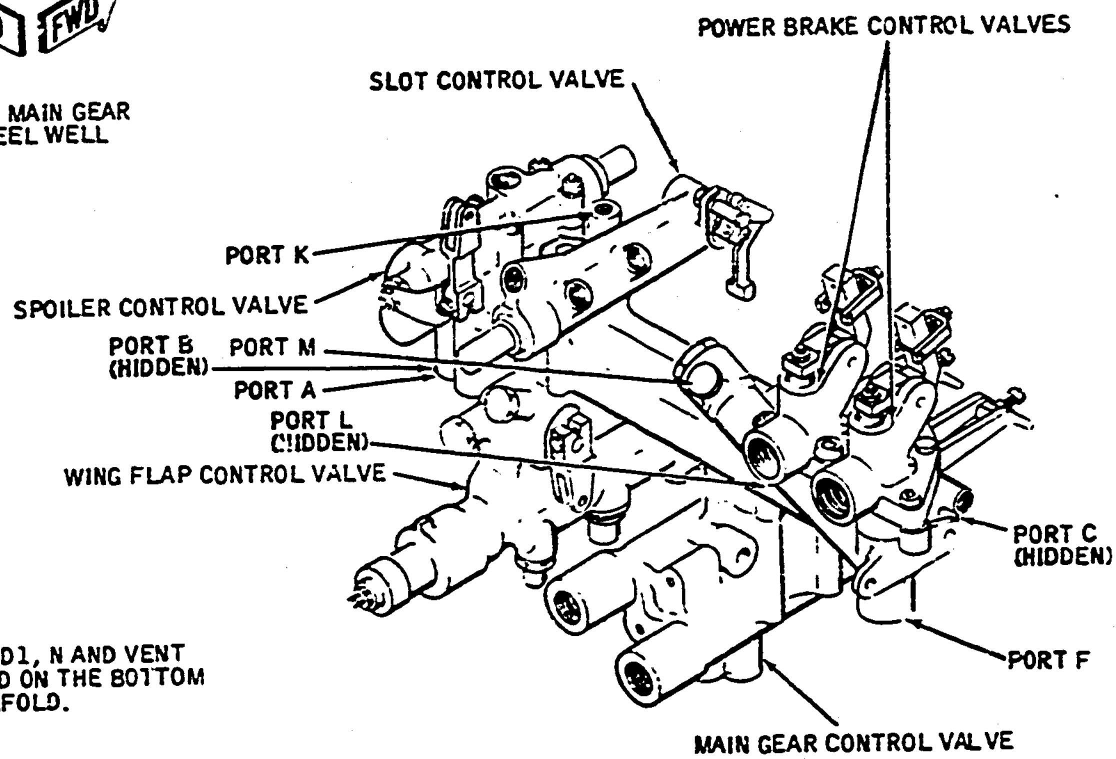
(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

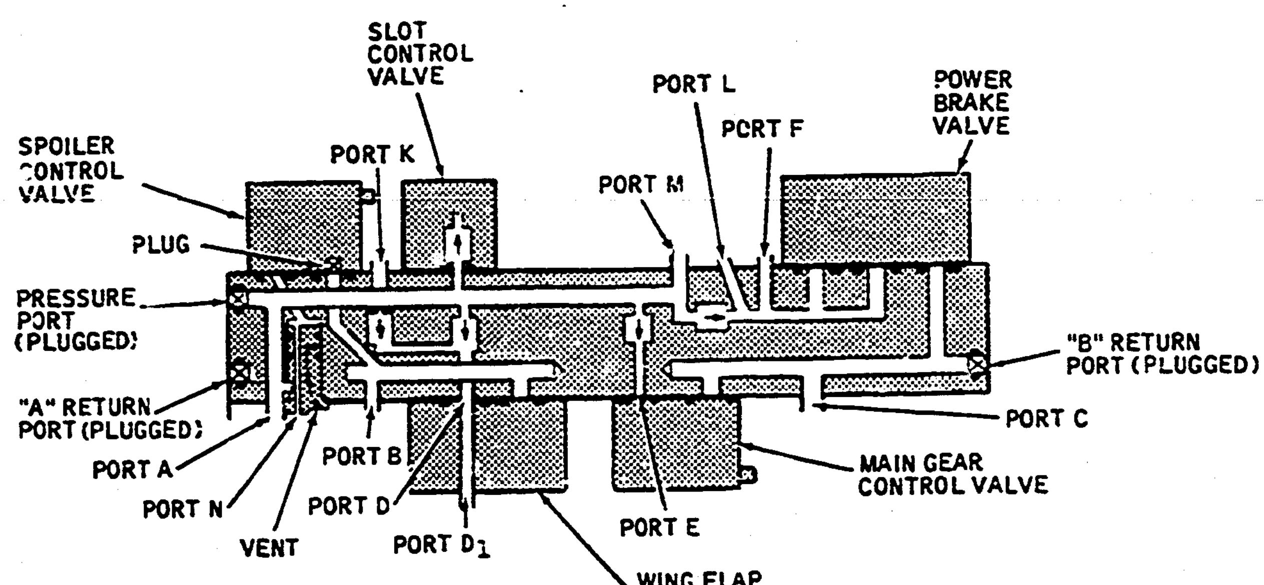
(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A' return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.





NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



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Right Hydraulic Power Manifold -- Schematic
Figure 19

R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 20.)

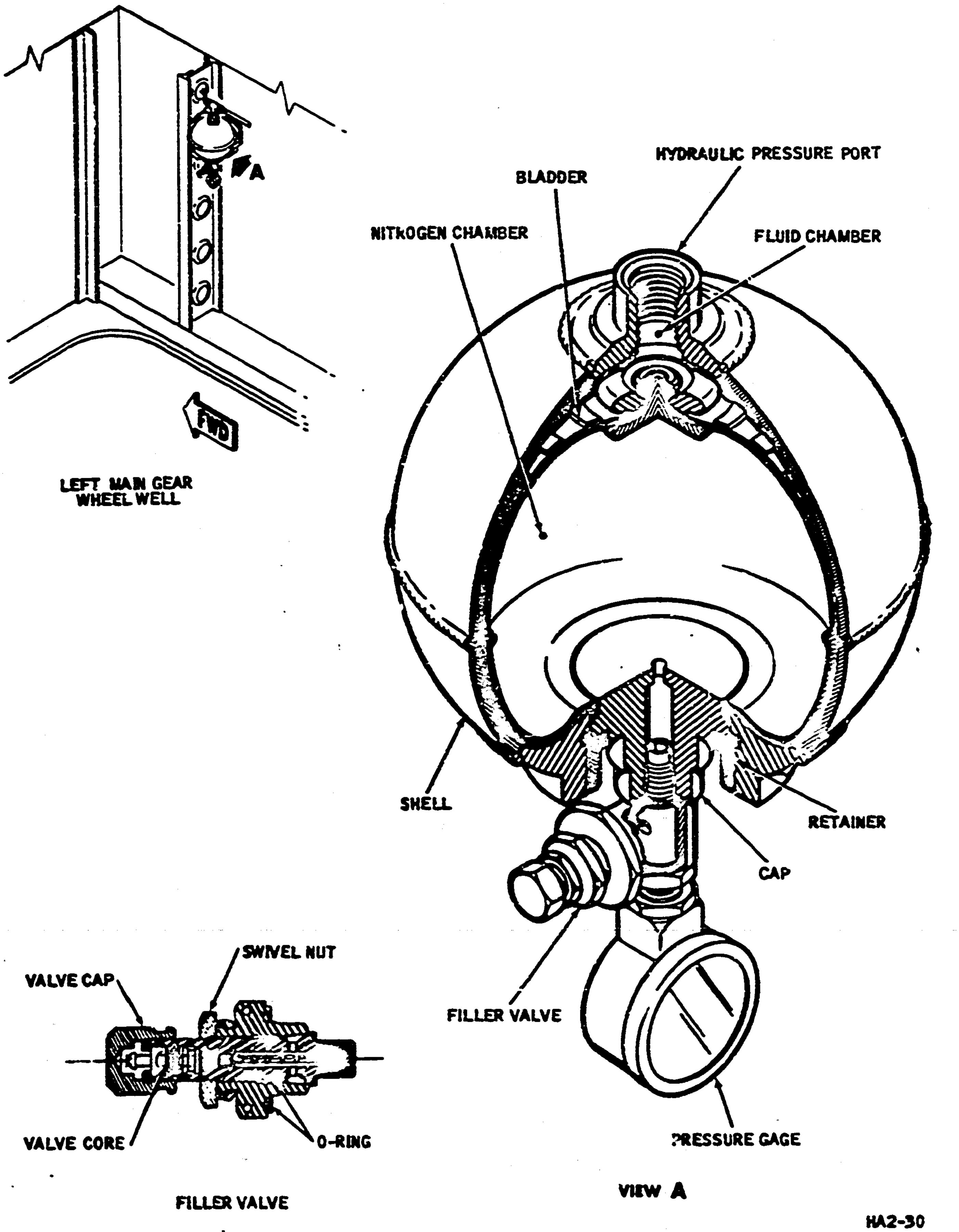
(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

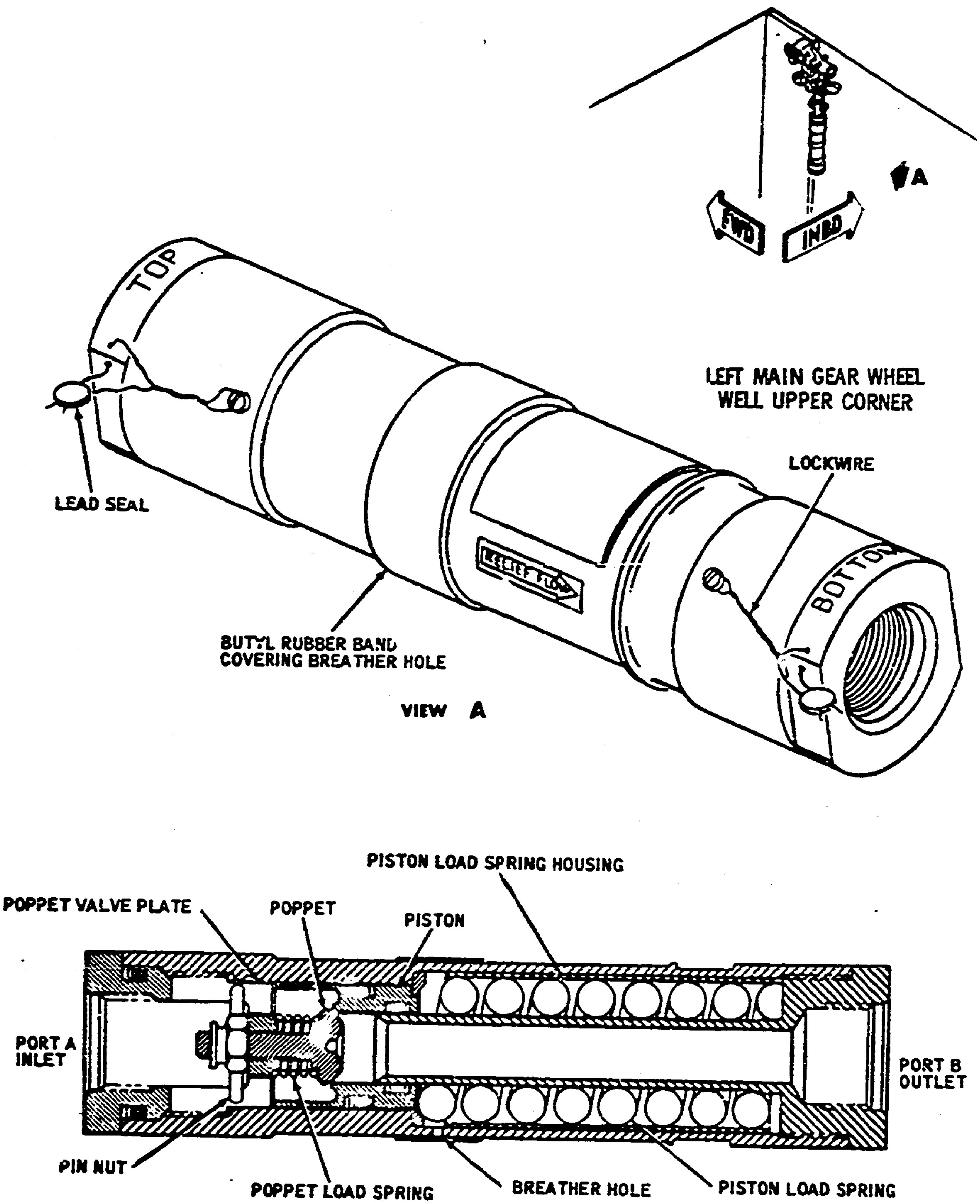
(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.



Hydraulic Power System Accumulator --
Cutaway View
Figure 20



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Hydraulic System Priority Valve -- Cutaway View
Figure 21

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

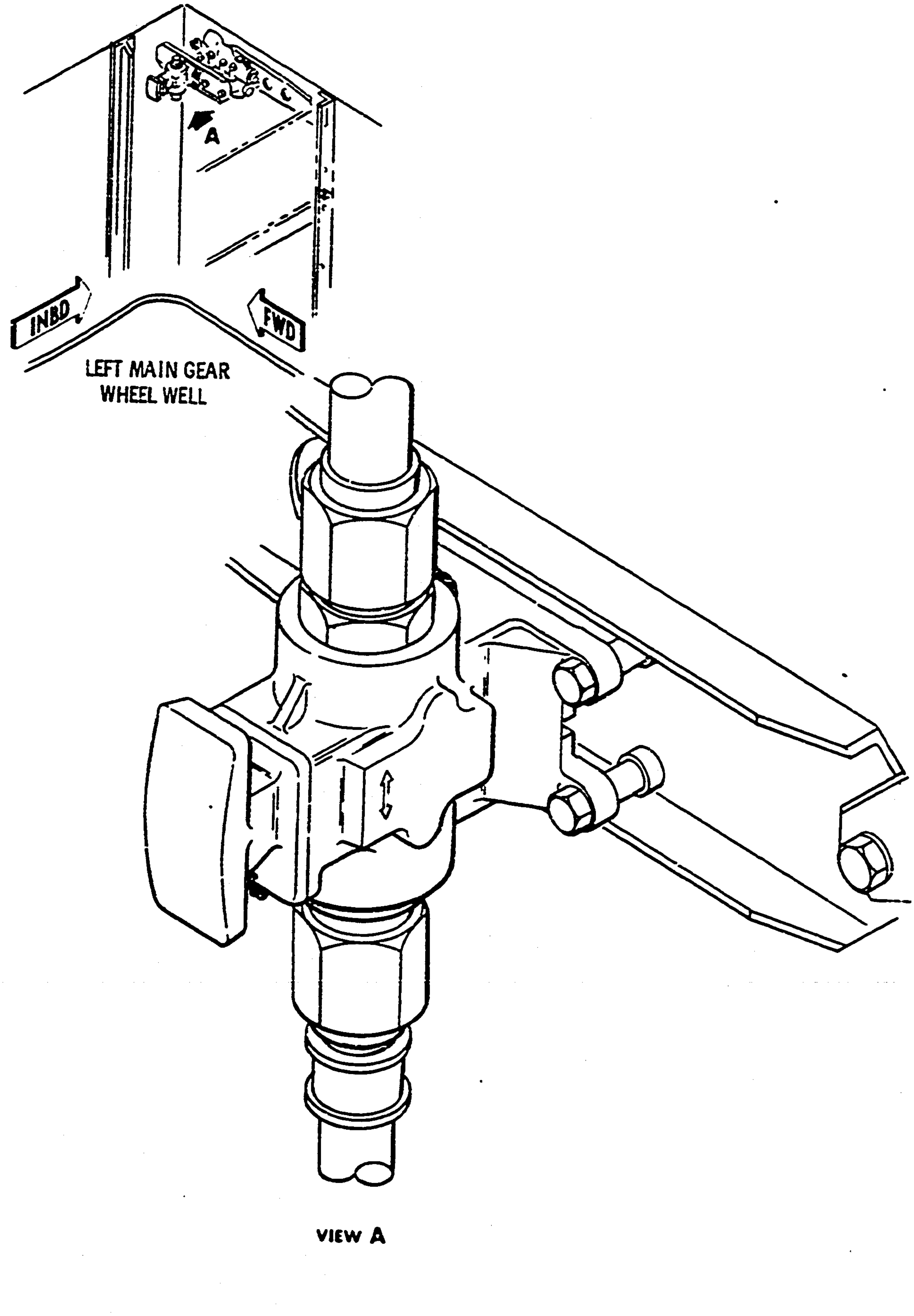
(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.



Manual Shutoff Valve
Figure 22

U. Manual Shutoff Valve (Airplane With S/B 29-67, See Figure 22)

(1) Two manually operated shutoff valves are provided just downstream of the priority valve for isolation of non-priority subsystems during maintenance operations. One valve shuts off pressure to the following subsystems:

(a) Wing flaps

(b) Wing slots

(c) Main landing gear retraction

(d) Power wheel brakes

(2) The other valve shuts off pressure to the nosegear retraction and nosewheel steering subsystems.

(3) The manual shutoff valves are located in the upper inboard forward corner of the left main gear wheel well. One valve is mounted on the left power manifold support, the other is mounted to a structure stiffener.

(4) The valves consist of two position (on-off), rotary type, valves with identical and interchangeable inlet and outlet ports. A T shaped handle is provided on each valve for manual operation and lockwire holes are provided in the base of the handle for safetying the valve in the open position.

V. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump

from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relieve valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system.

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

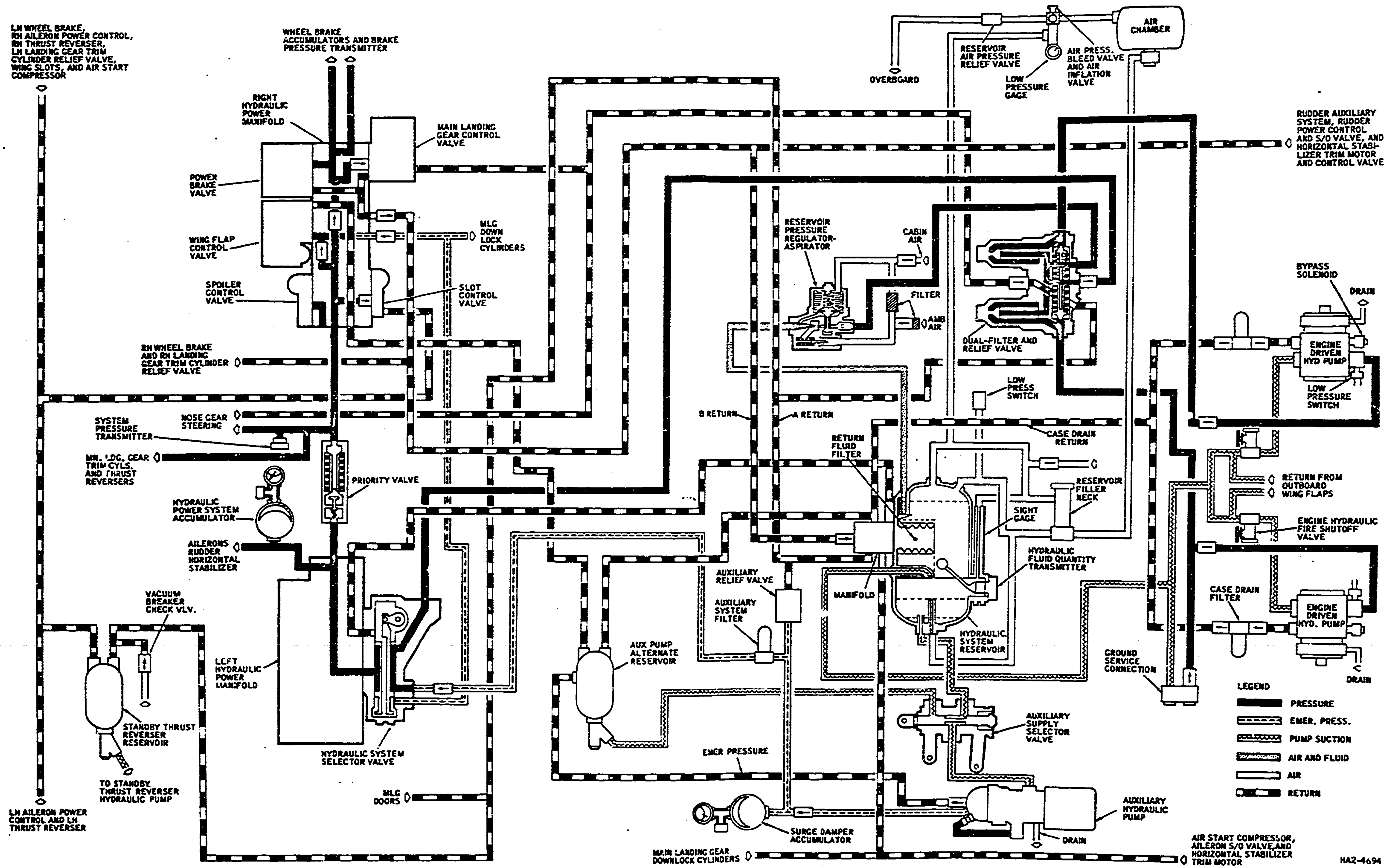
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

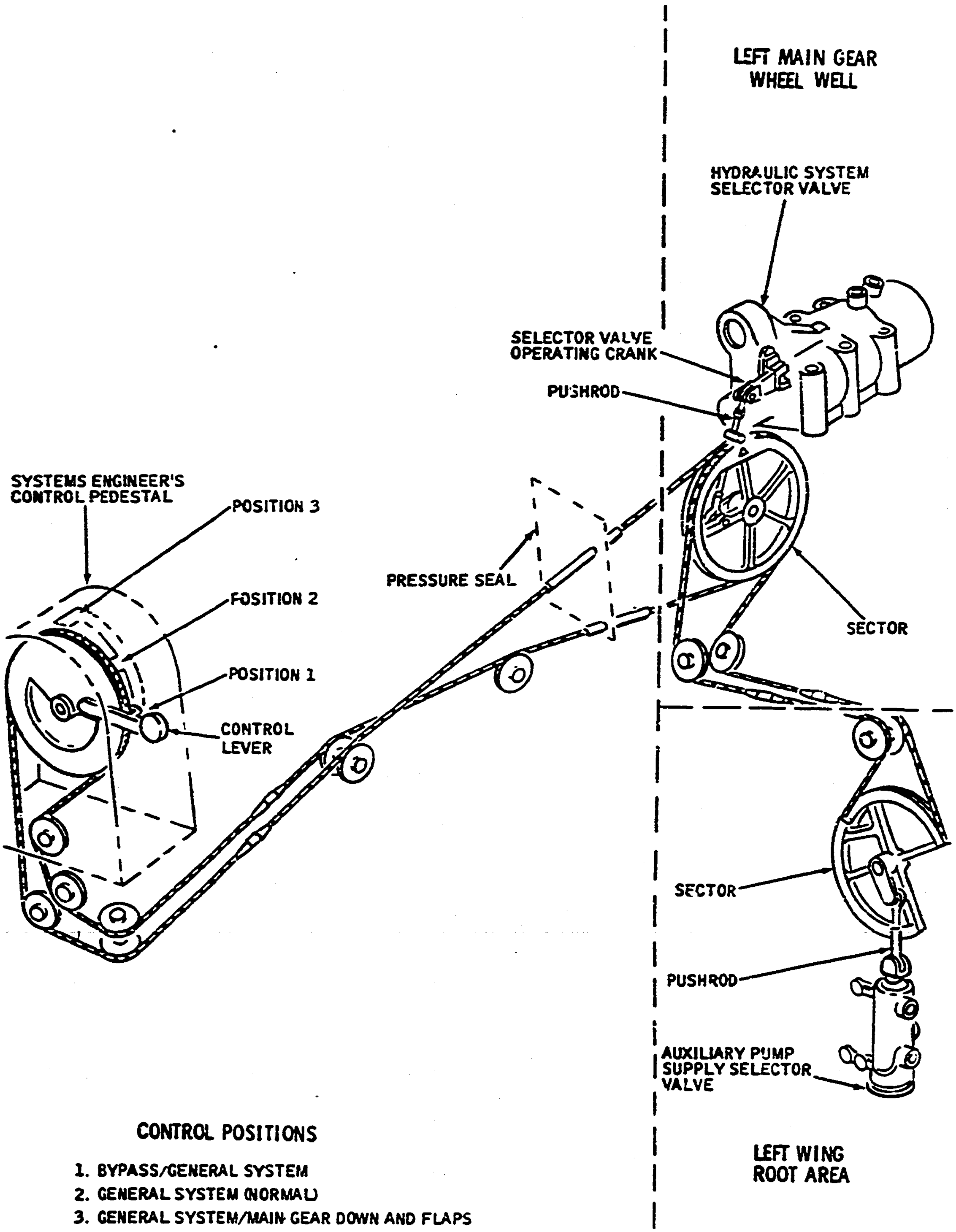
(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from



Hydraulic Power System -- Schematic Diagram
Figure 1



Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately 3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via a return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff.

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A

return line. All return fluid entering the reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the systems selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pump pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

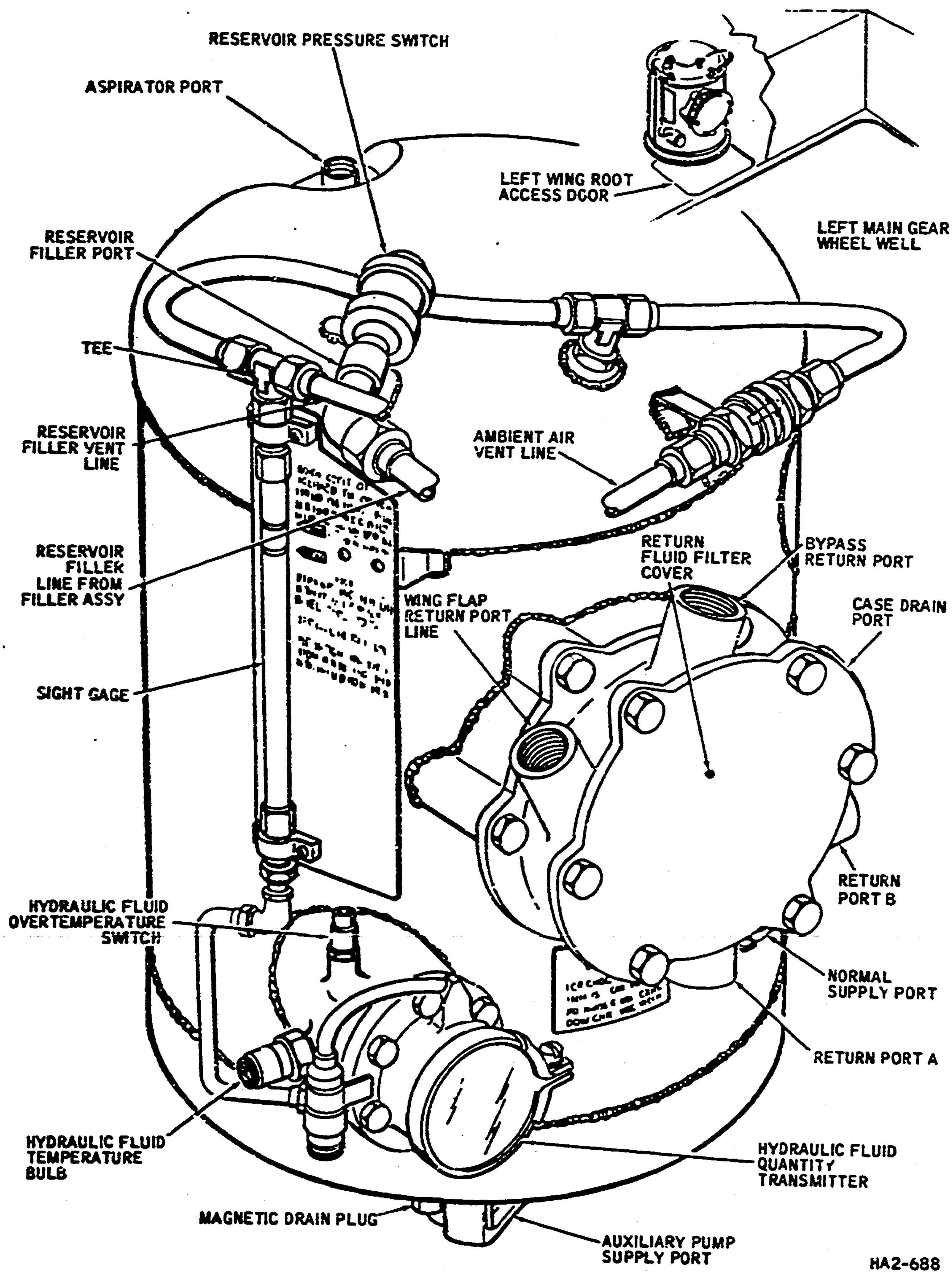
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

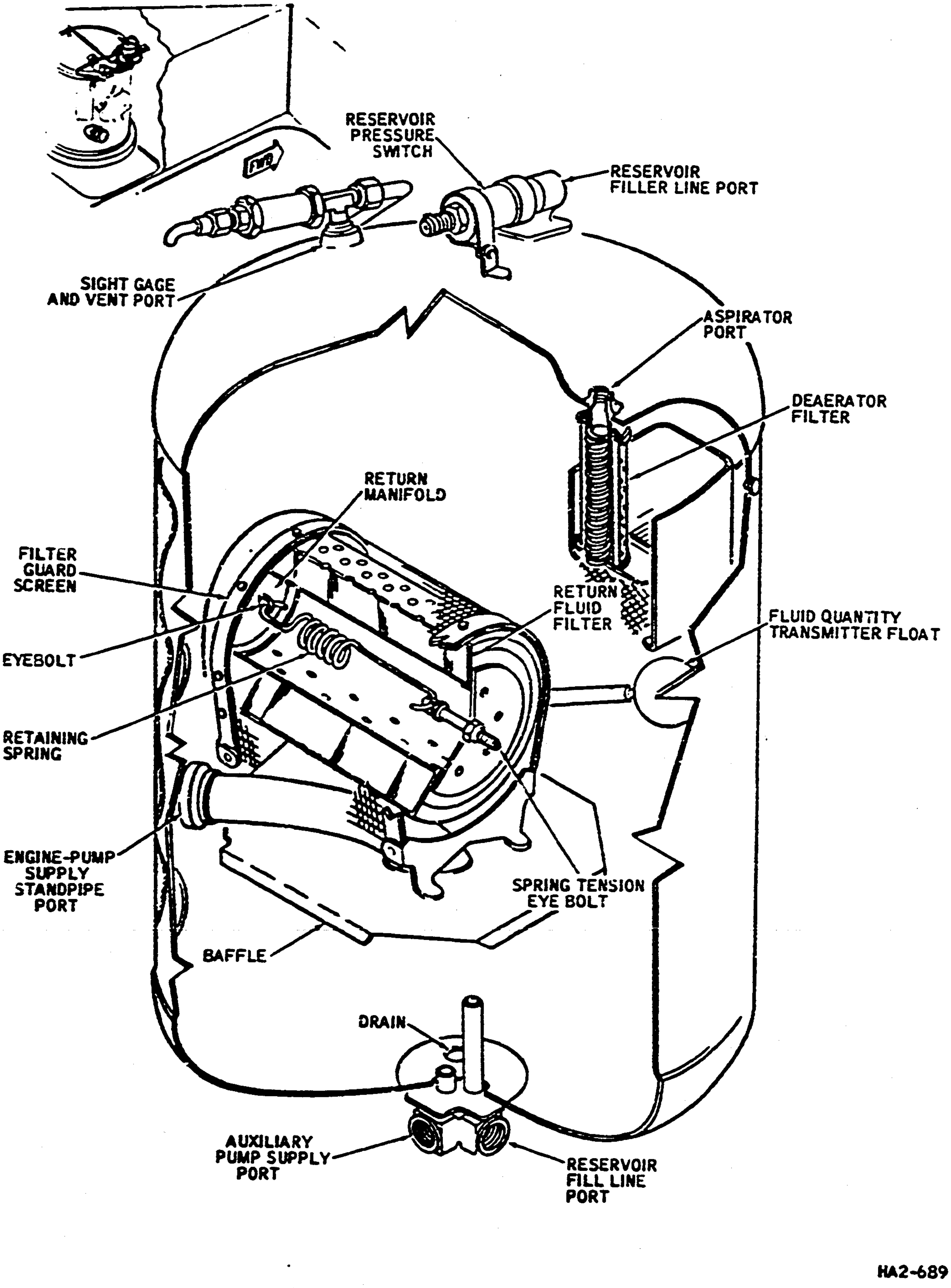
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the



Hydraulic System Reservoir -- External View
Figure 3



Hydraulic System Reservoir -- Cutaway View
Figure 4

reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold

by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

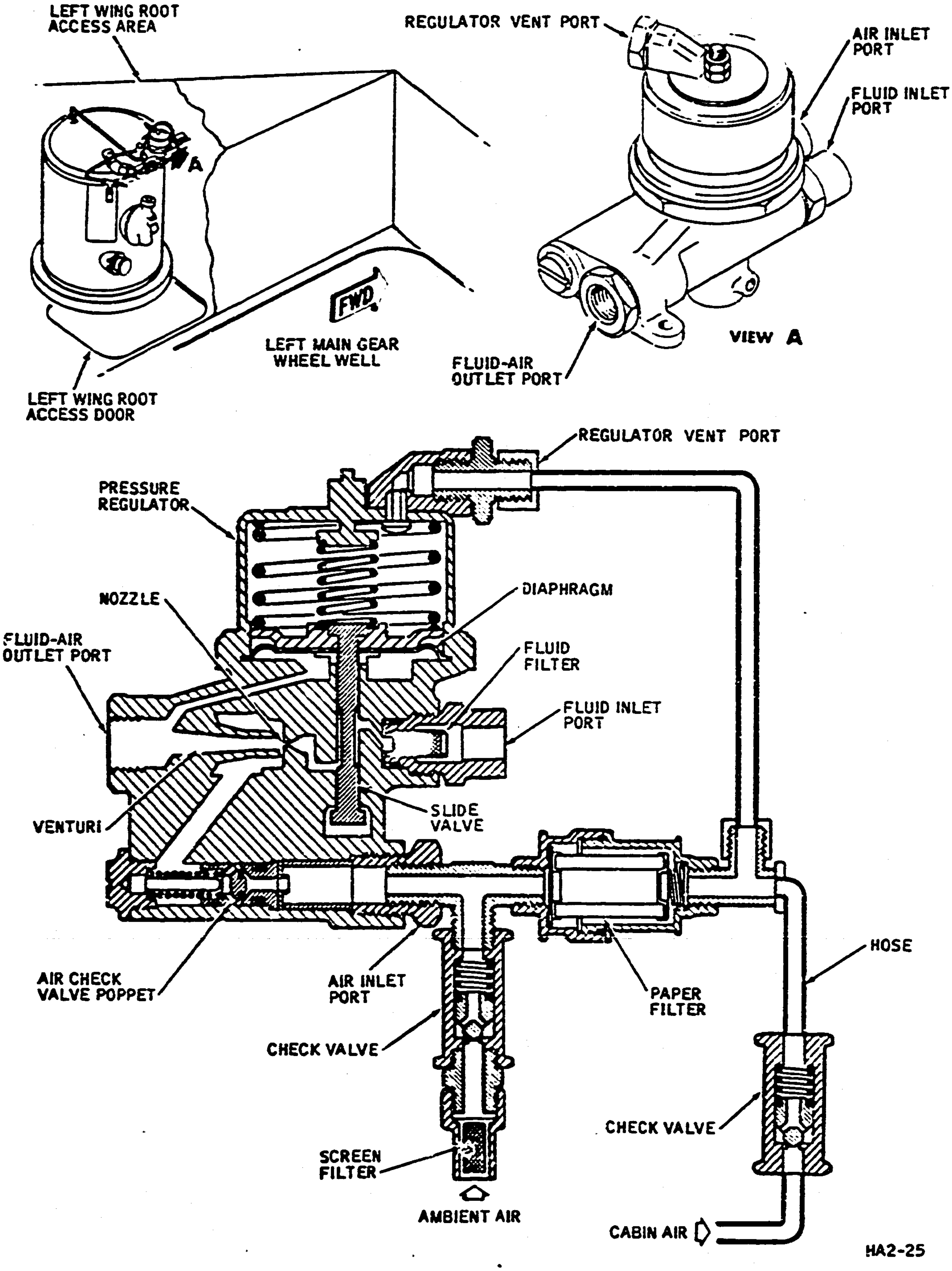
(3) Internally, the filter has a 10-micron, resin-impregnated convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around



Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the diaphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the diaphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

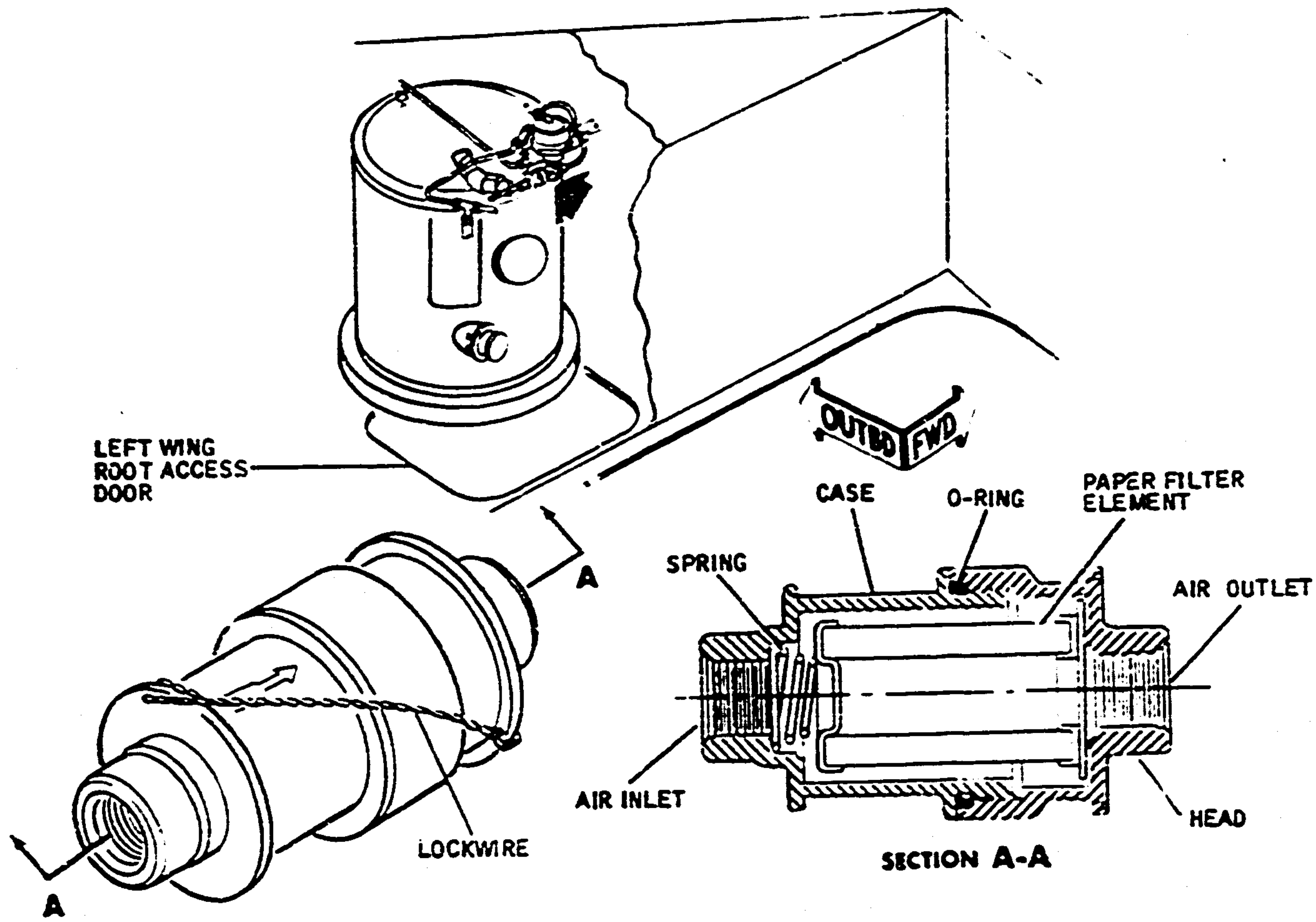
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

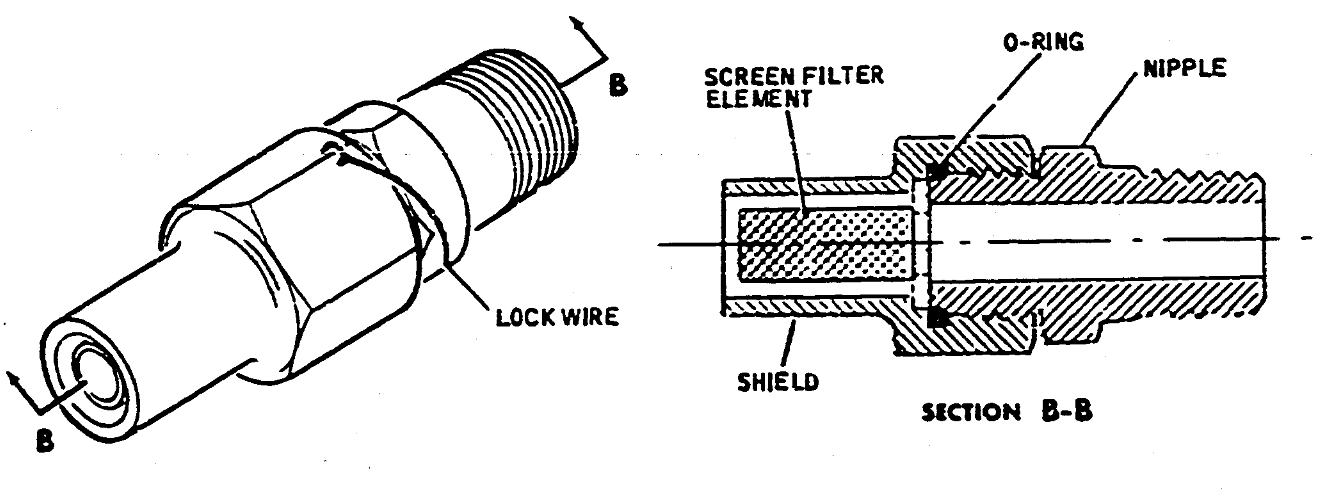
(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to pressurize the main hydraulic system reservoir. The filtering system is composed of two filters, One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.



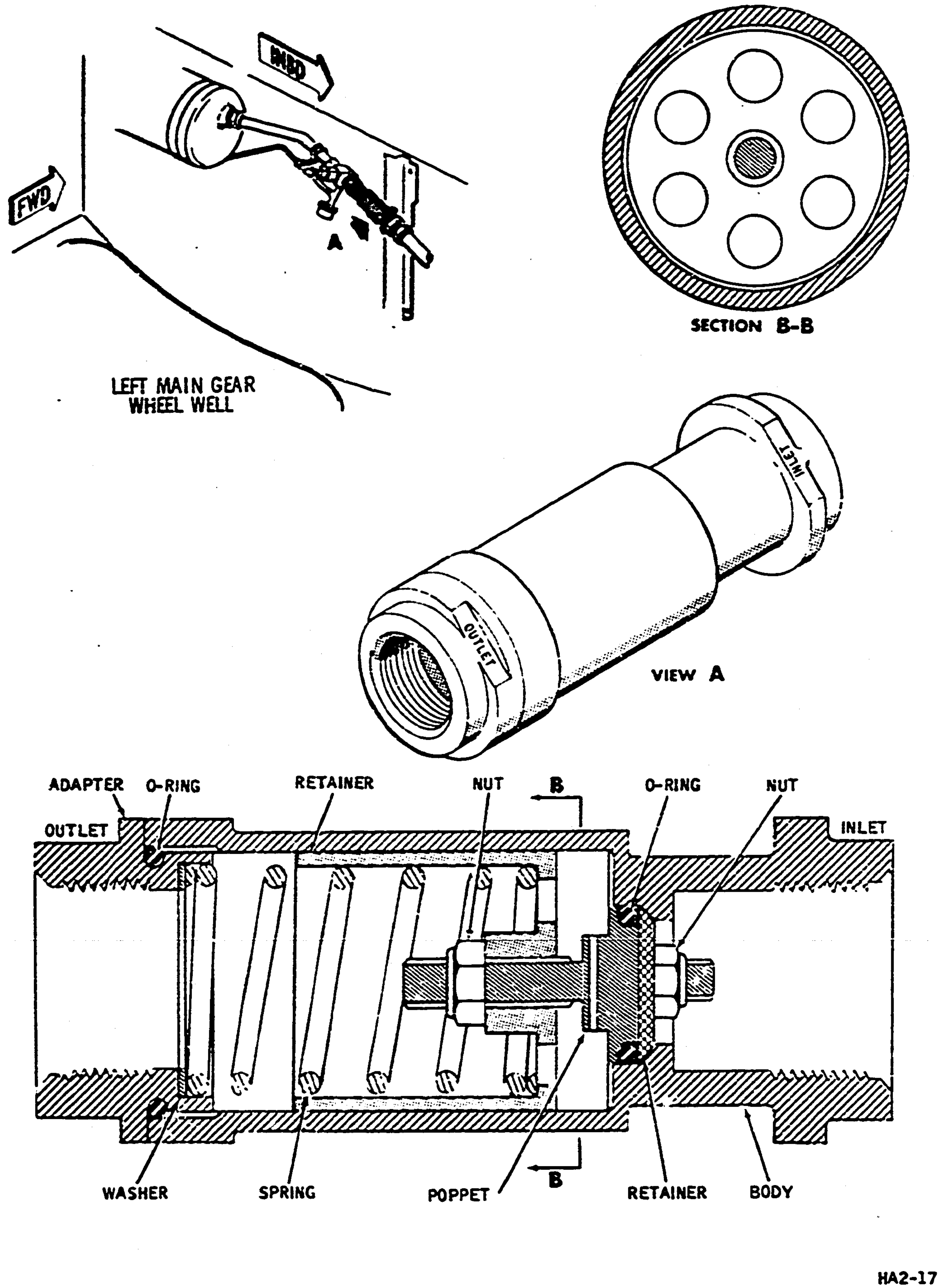
PAPER ELEMENT FILTER



SCREEN FILTER

HA2-35

Regulator-Aspirator Air Filters -- Cutaway View
Figure 6



Hydraulic Reservoir Relief Valve
Figure 7

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chambers and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

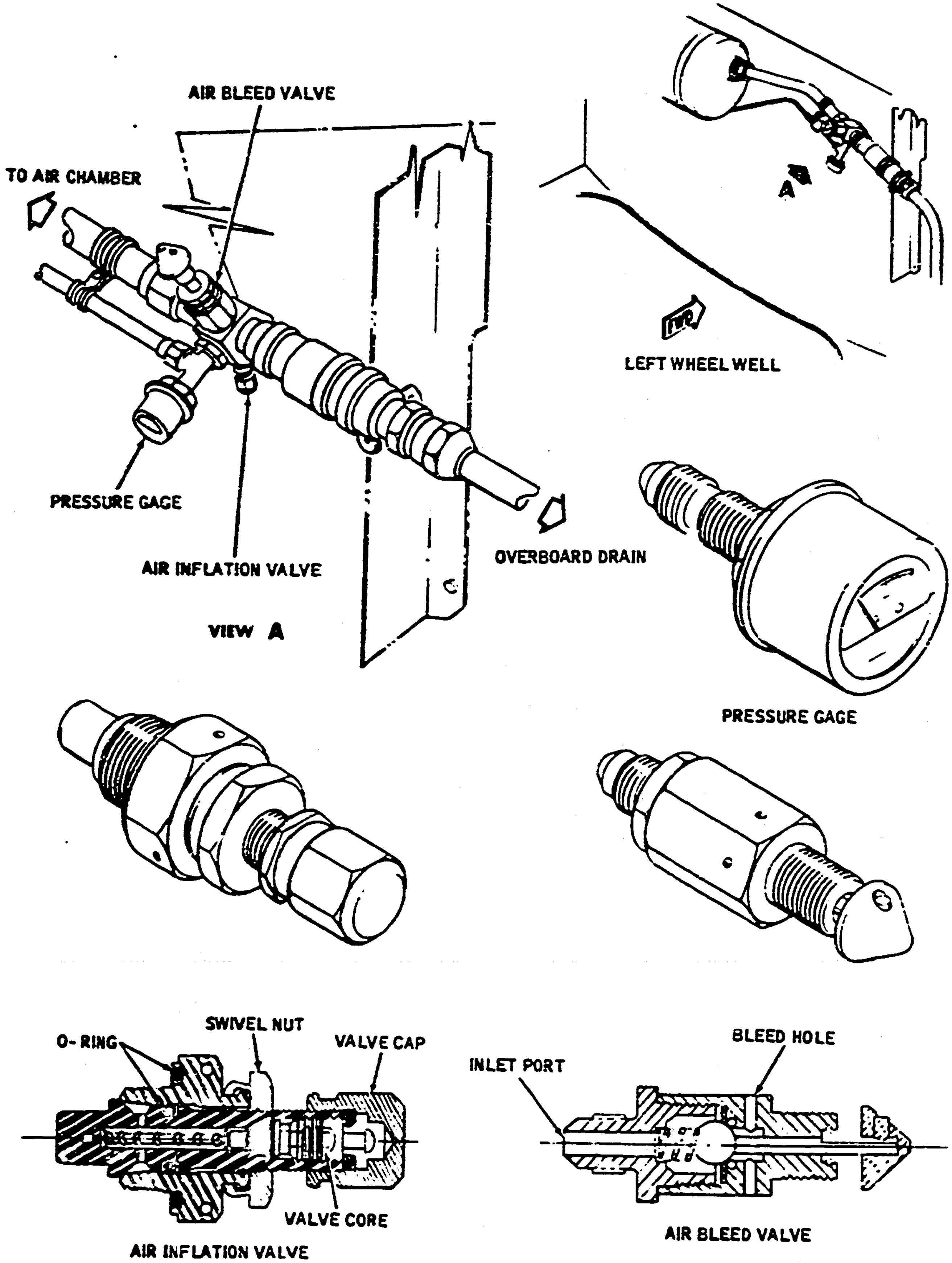
G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

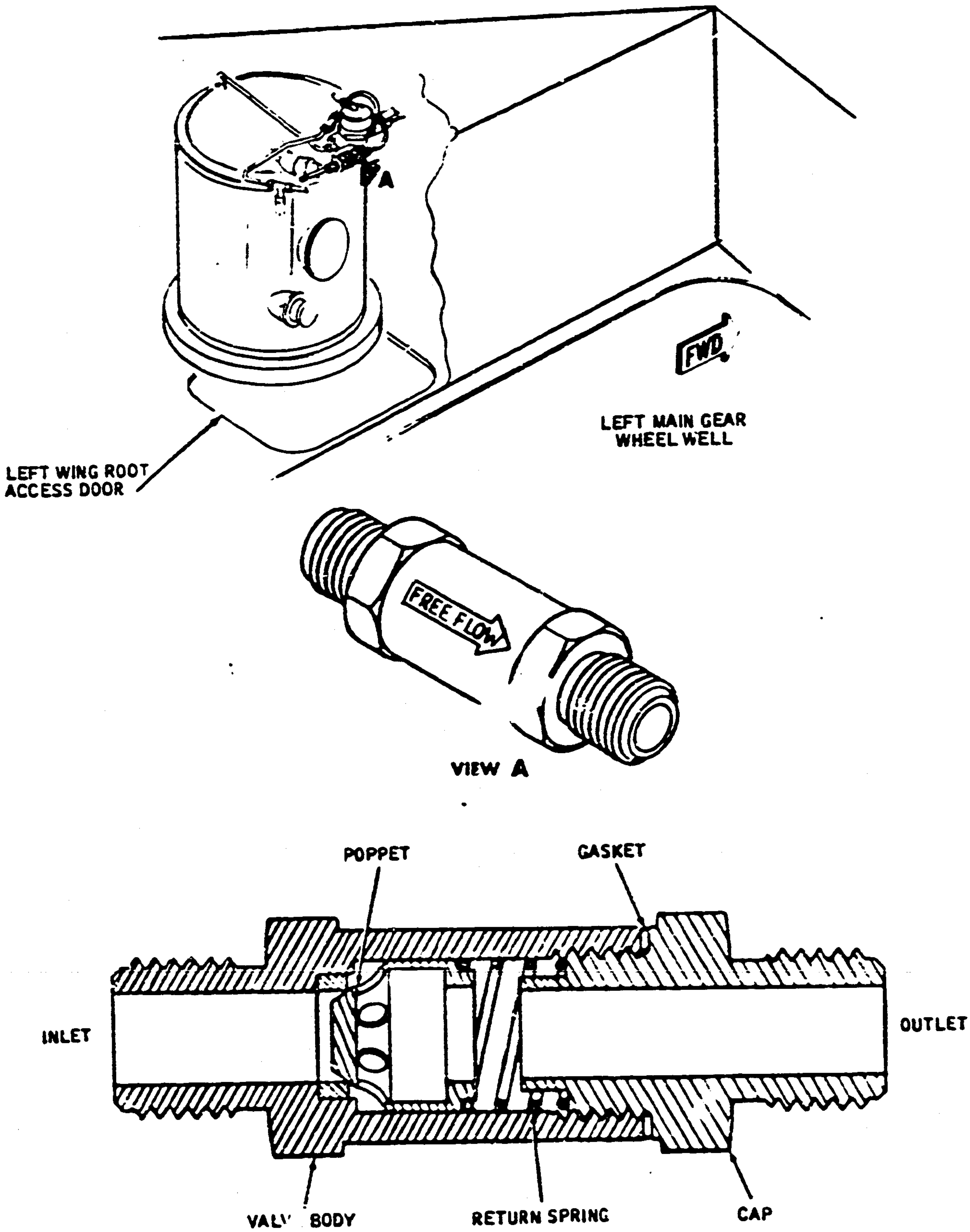
H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8



HA2-33

Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

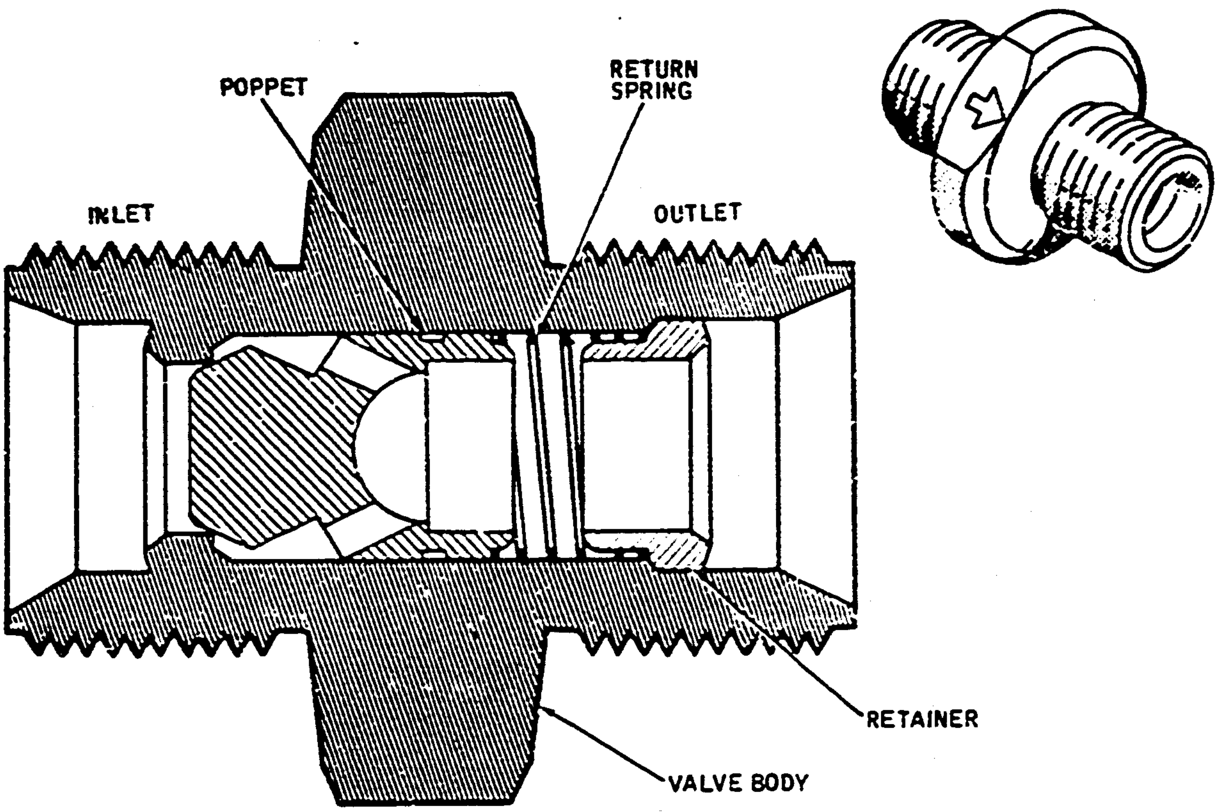
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

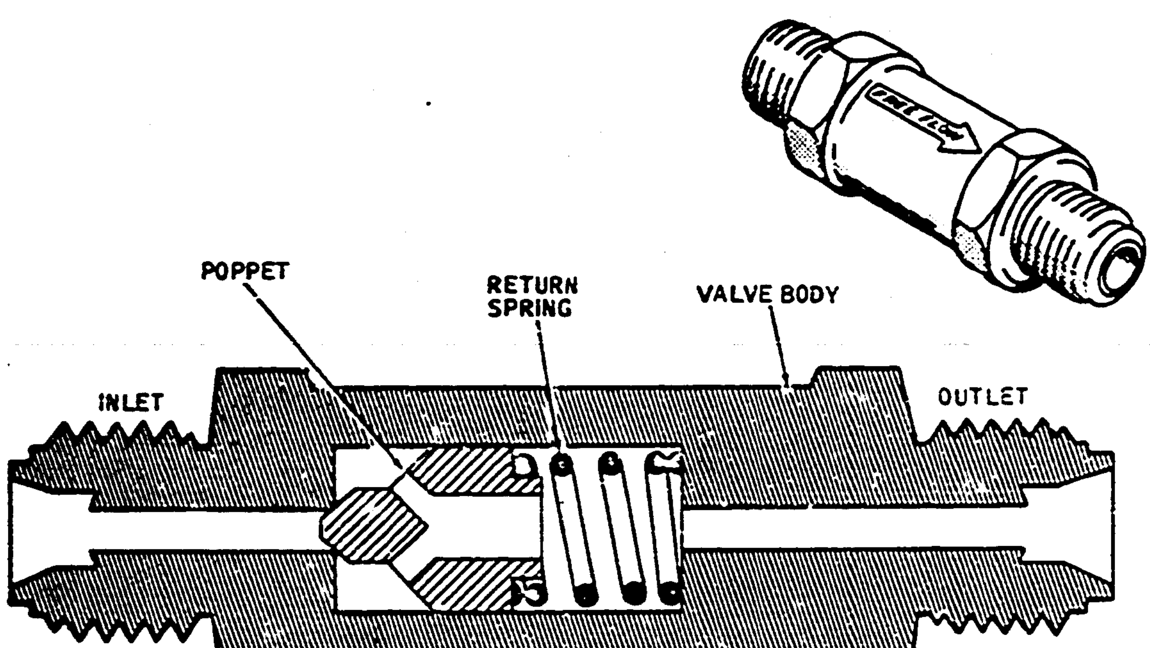
(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link-roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.



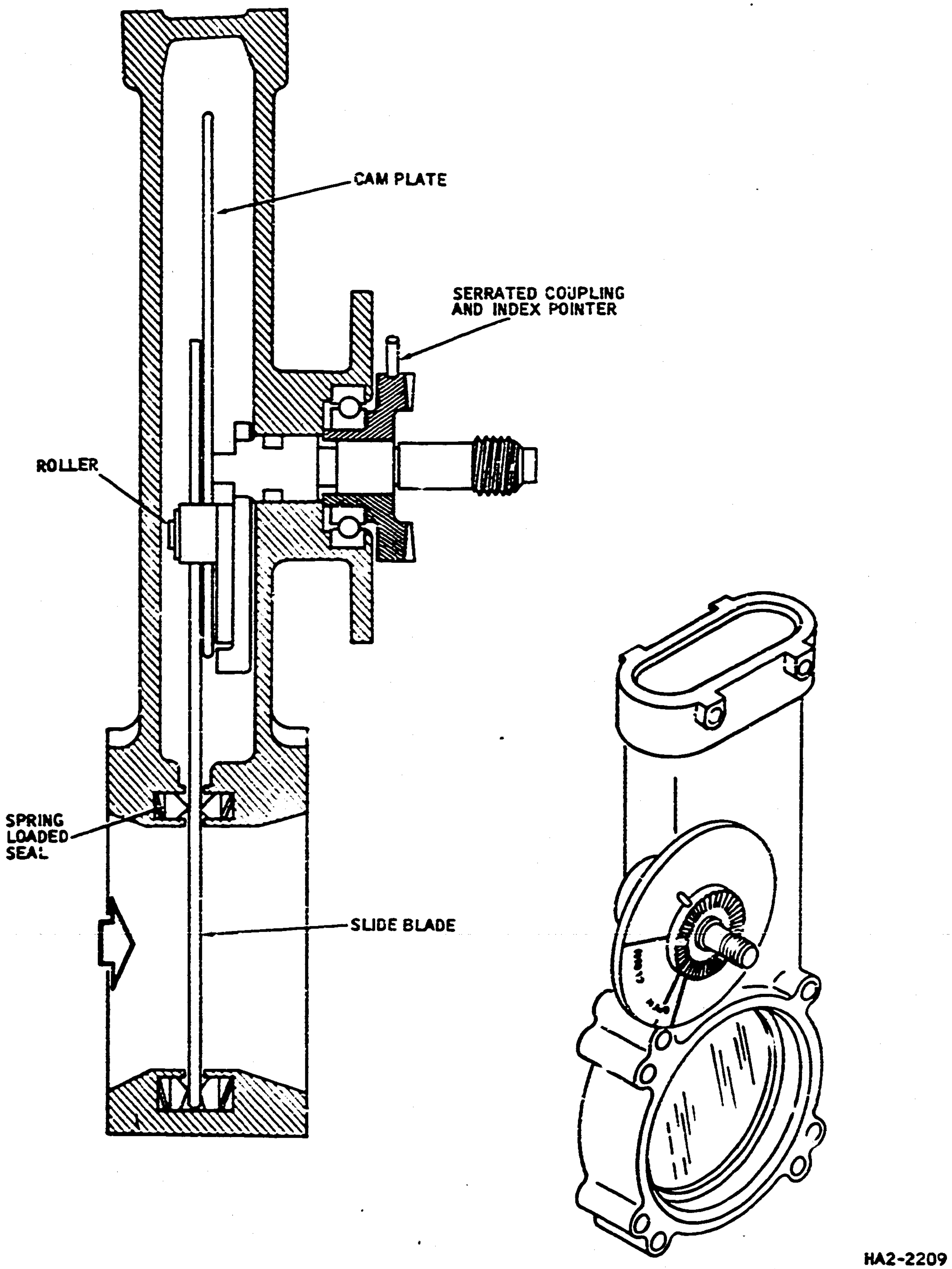
MINIATURE CHECK VALVE



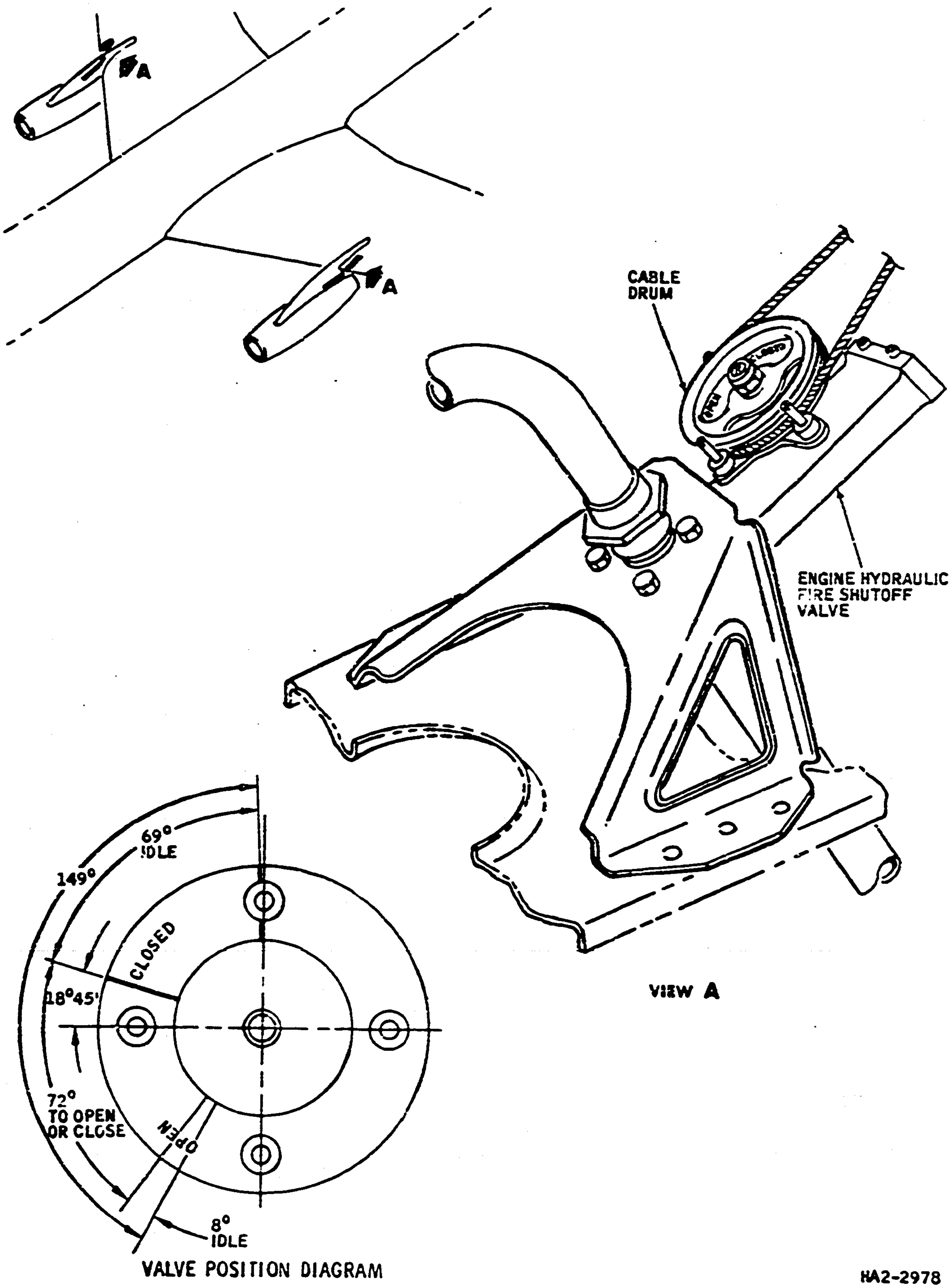
STANDARD CHECK VALVE

HA2-18A

Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

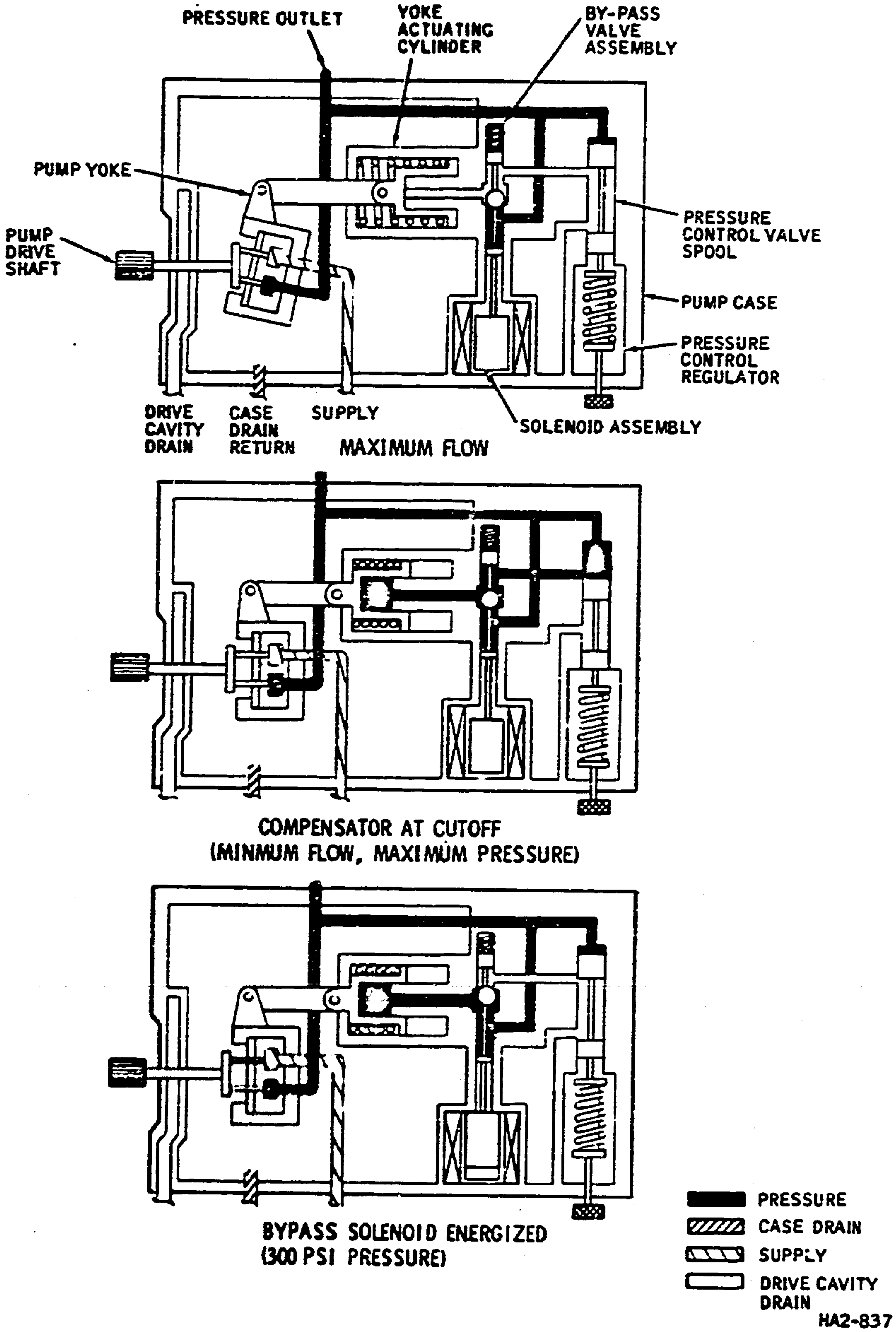
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is



Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulators meter the pressure to the yoke control piston, which position the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduced from maximum flow to zero flow and 3000 psi is reached. The pump stabilizes in accordance with system demand.

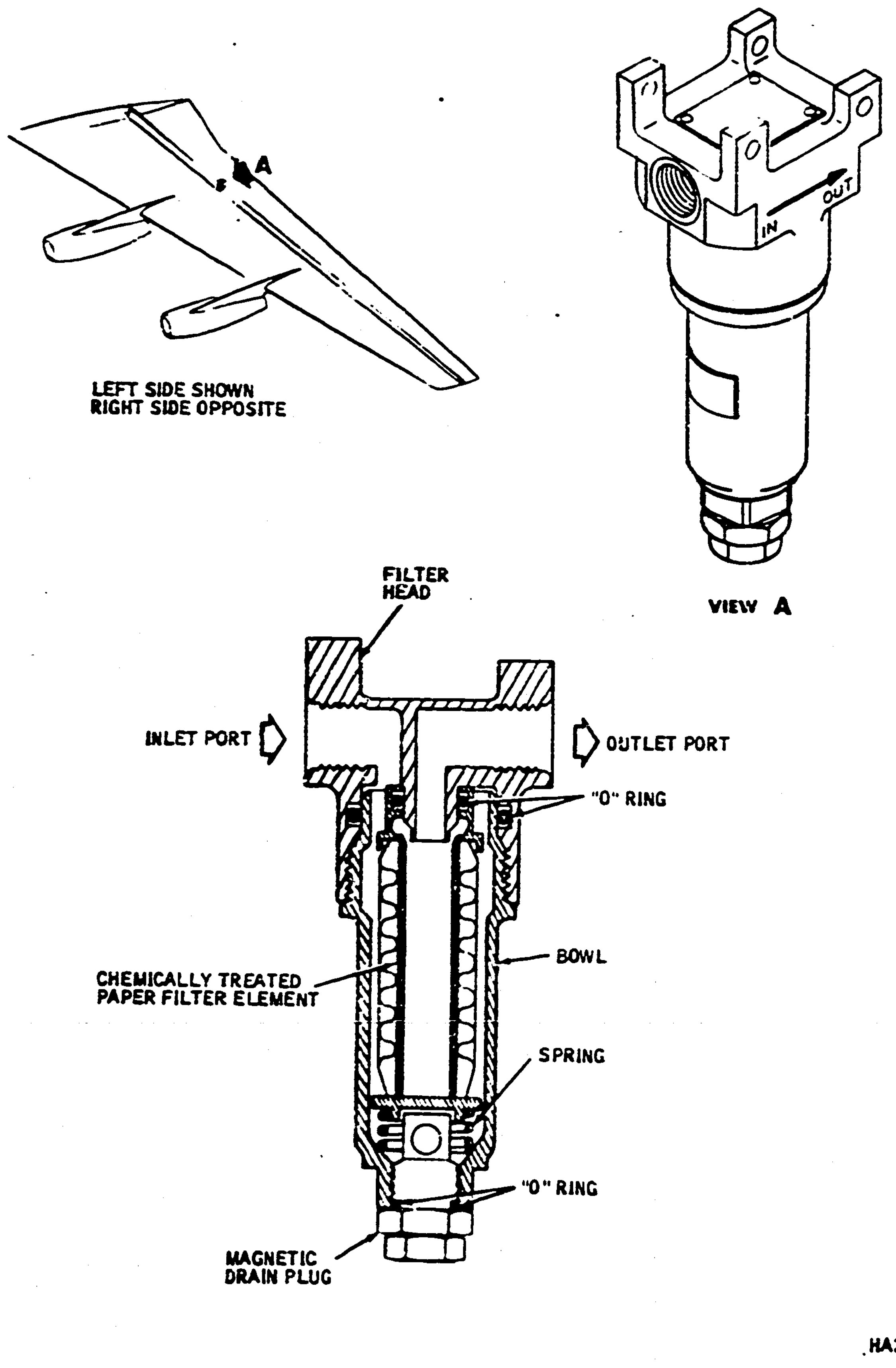
L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by



Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14

lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.

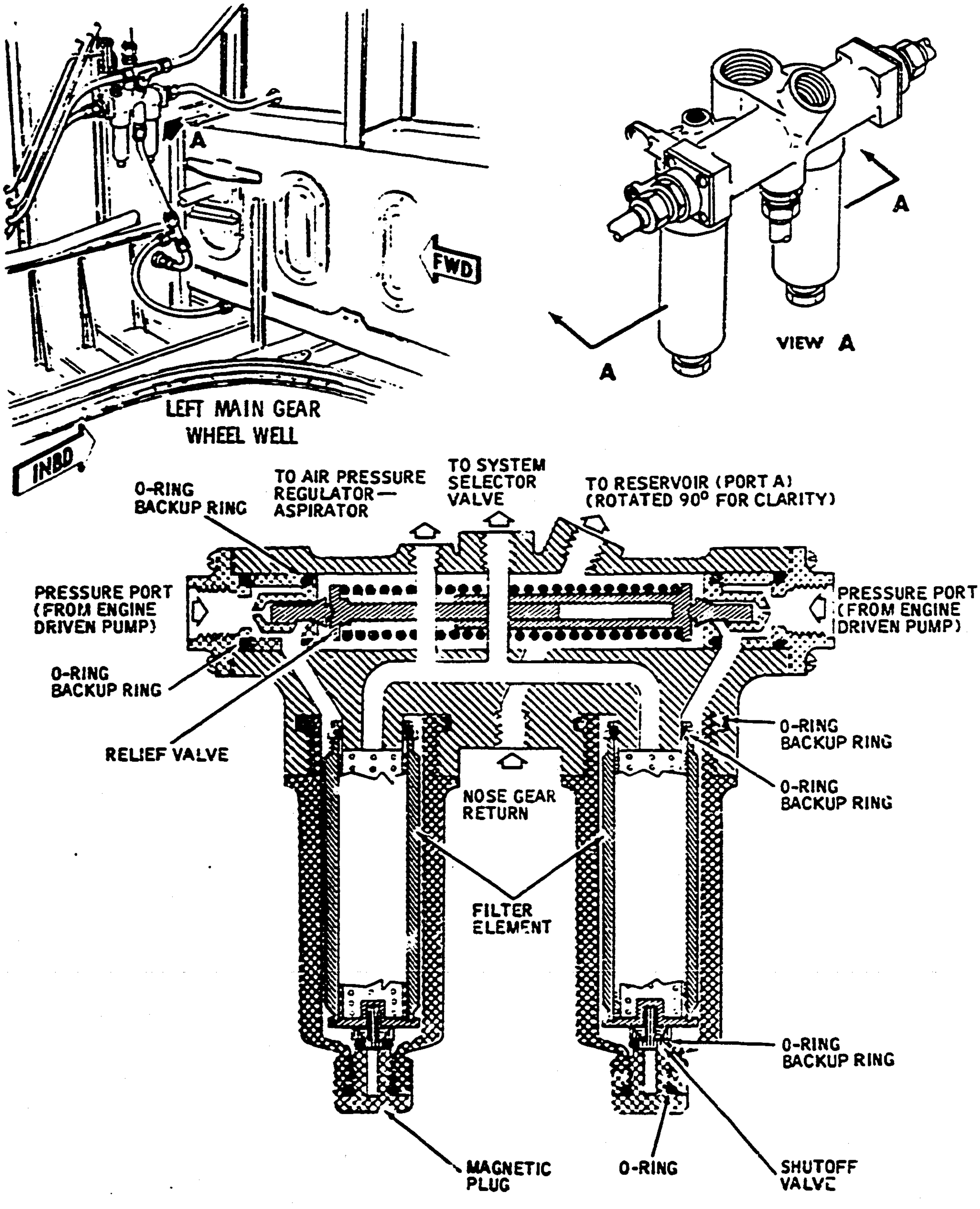
(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3000 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

(5) A check valve is installed in the system selector valve port to prevent reverse flow or pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

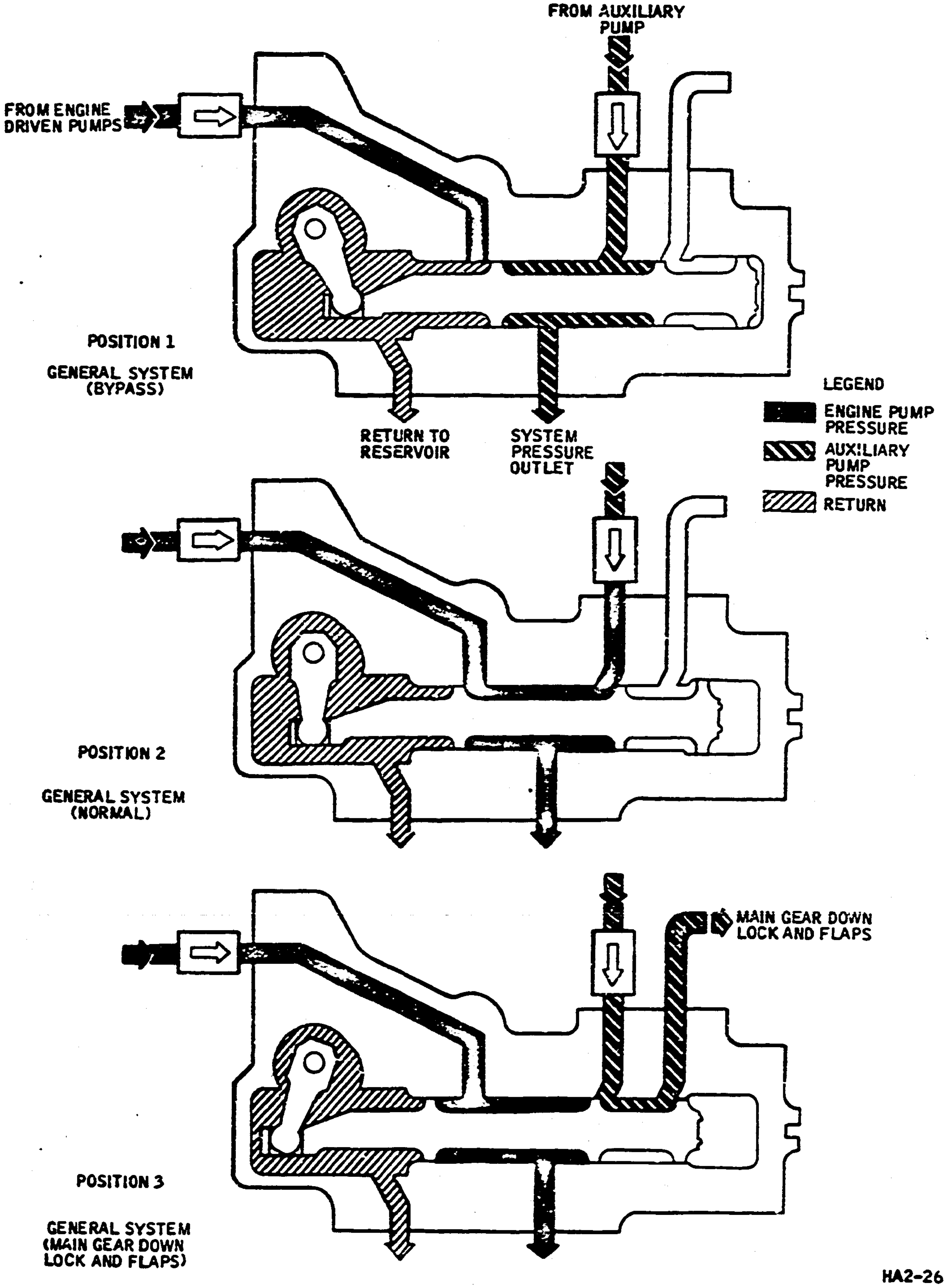
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.



SECTION A-A

HA2-20

Dual-Filter and Relief Valve -- Cutaway View
Figure 15



System Selector Valve -- Schematic
Figure 16

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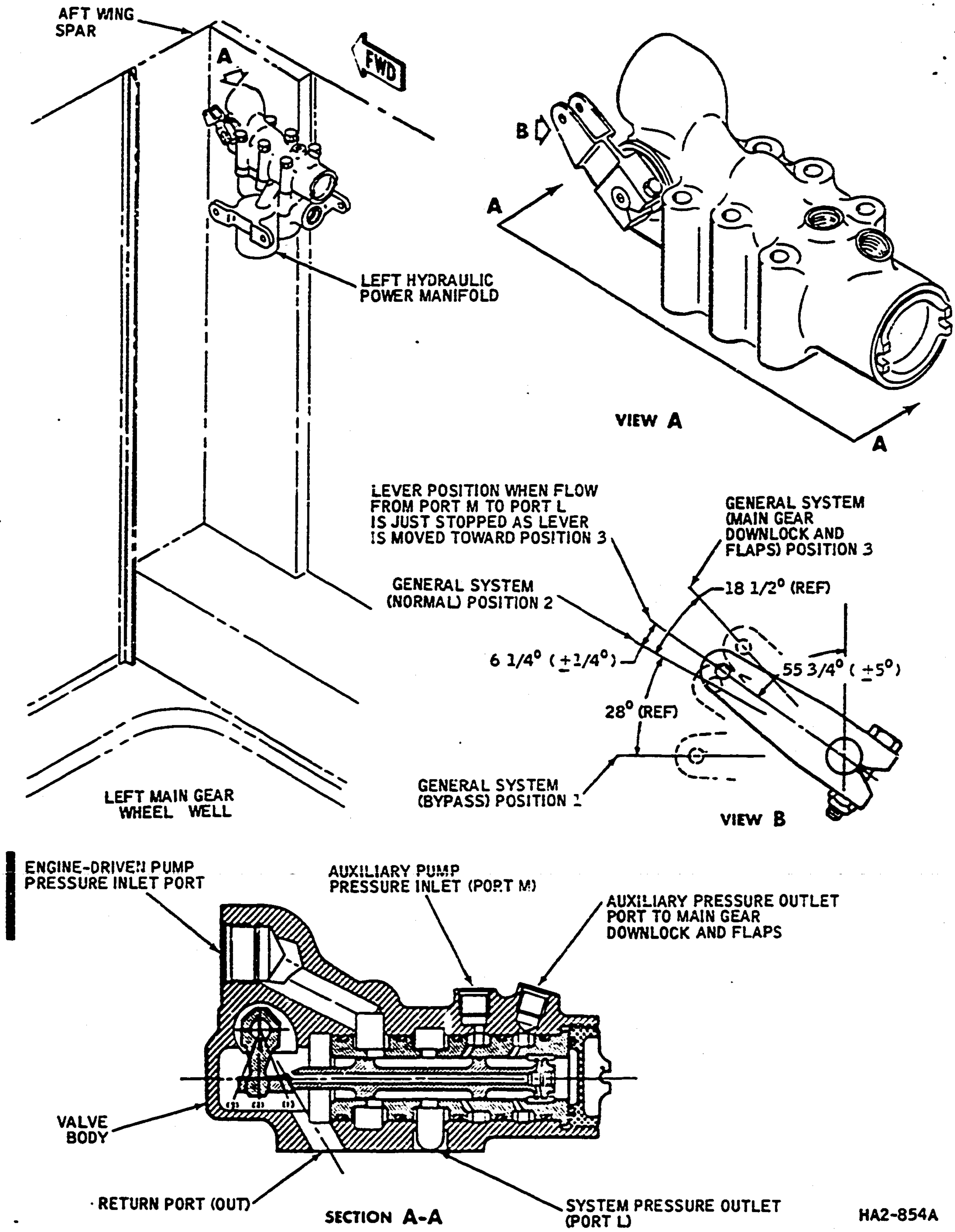


System Selector Valve -- Cutaway View
Figure 17

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position, the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear downlock and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps. Internal leakage provides lubrication for the moving parts of the valve.

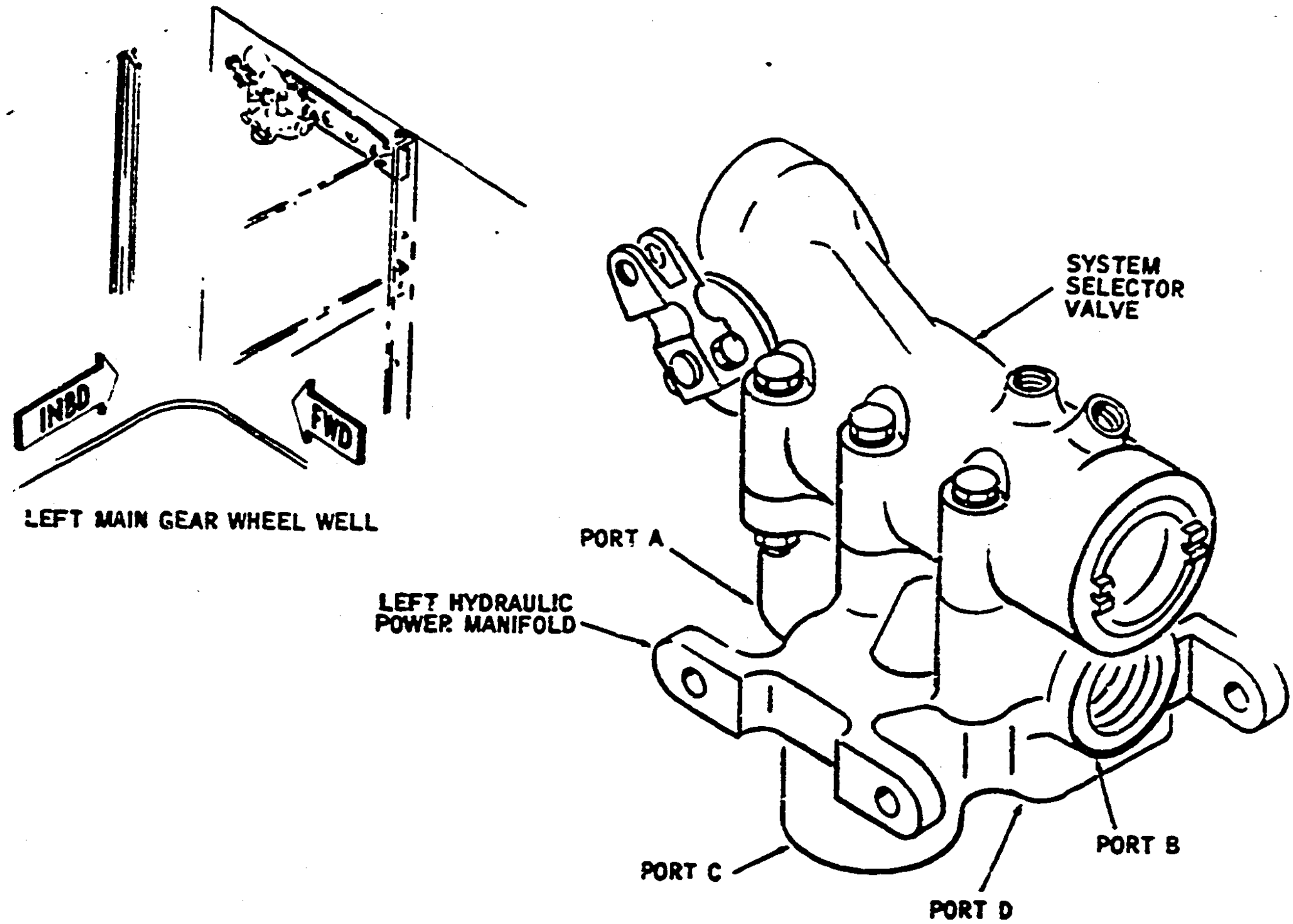
P. Left Hydraulic Power Manifold (See Figure 18.)

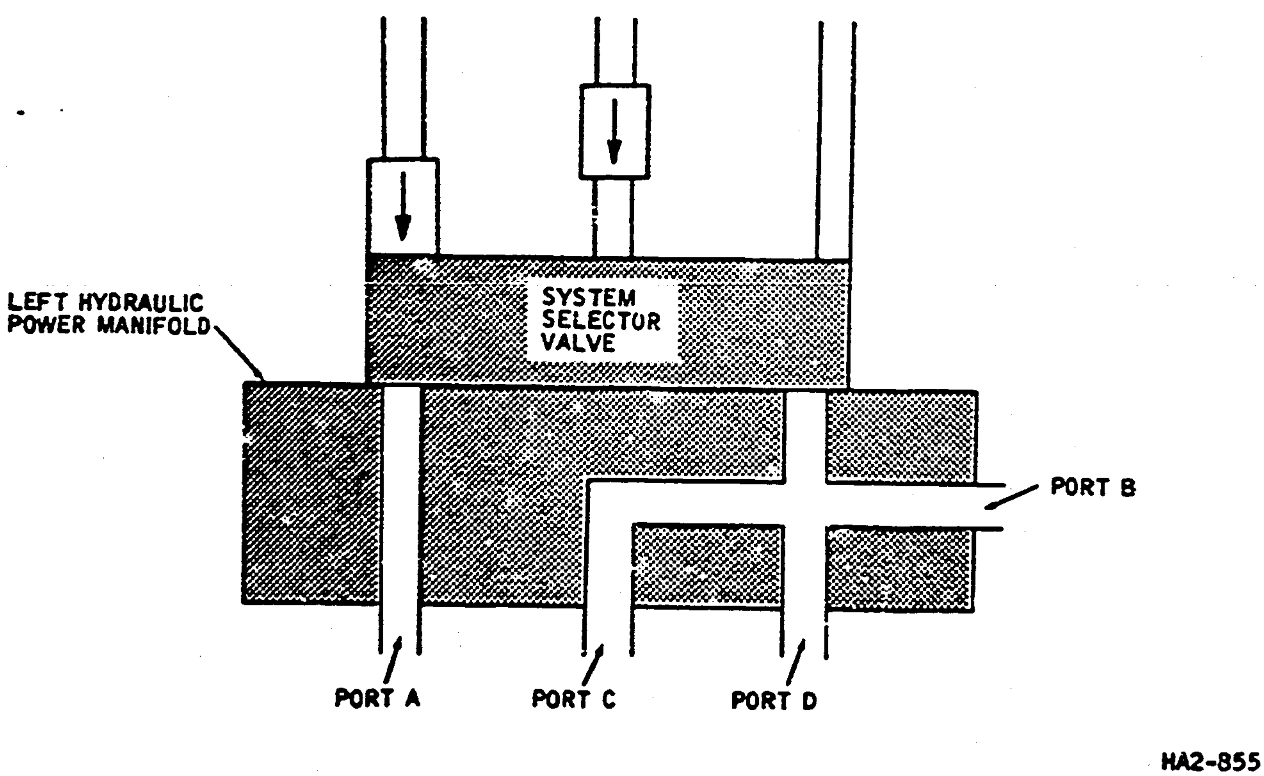
(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

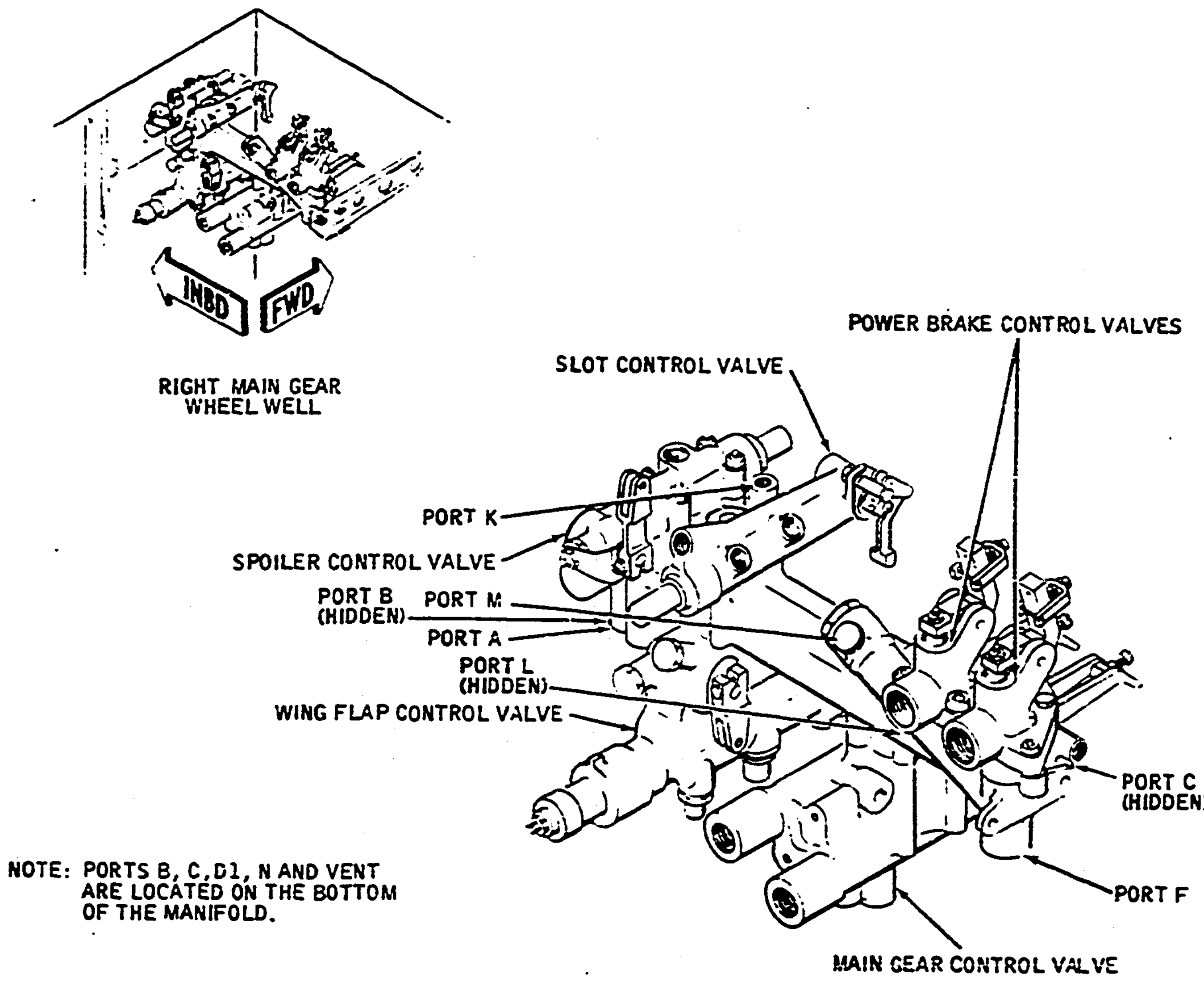
Q. Right Hydraulic Power Manifold (See Figure 19.)

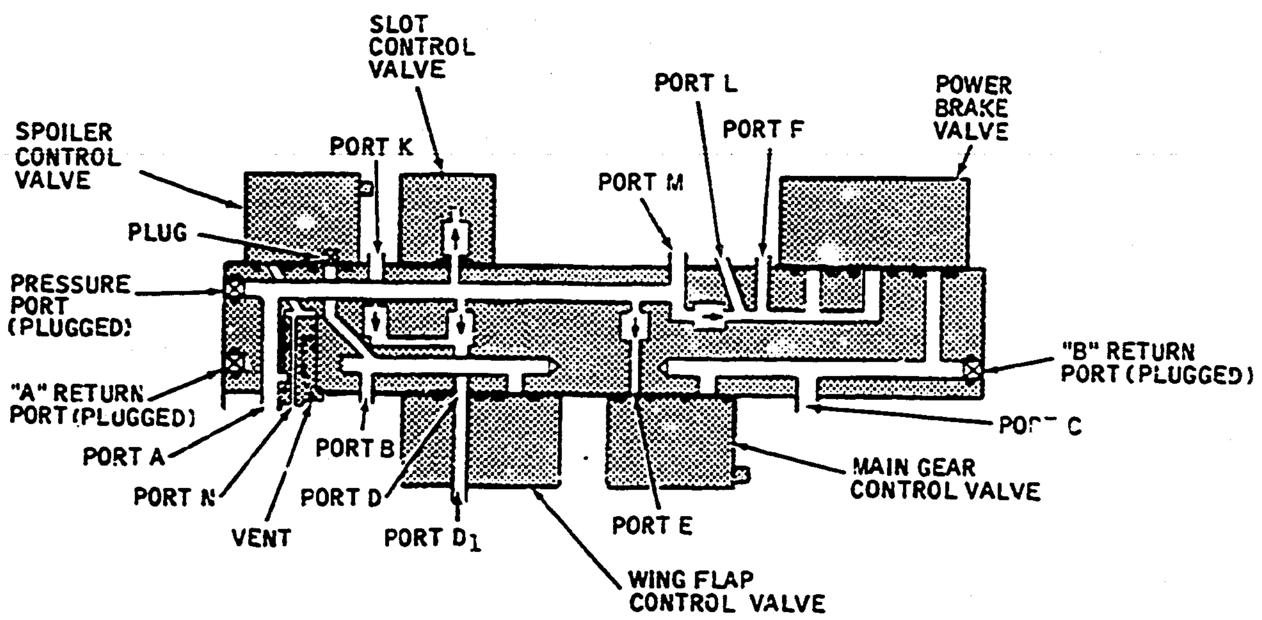
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in





Left Hydraulic Power Manifold -- Schematic
Figure 18





HA2-29A

Right Hydraulic Power Manifold -- Schematic
Figure 19

the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

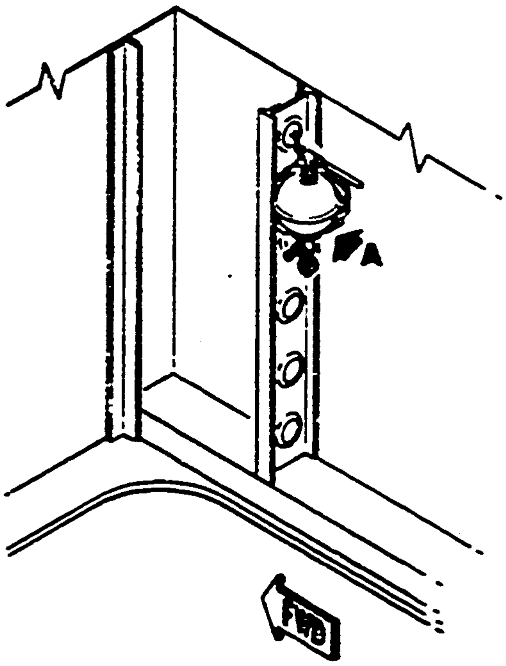
(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Deleted.

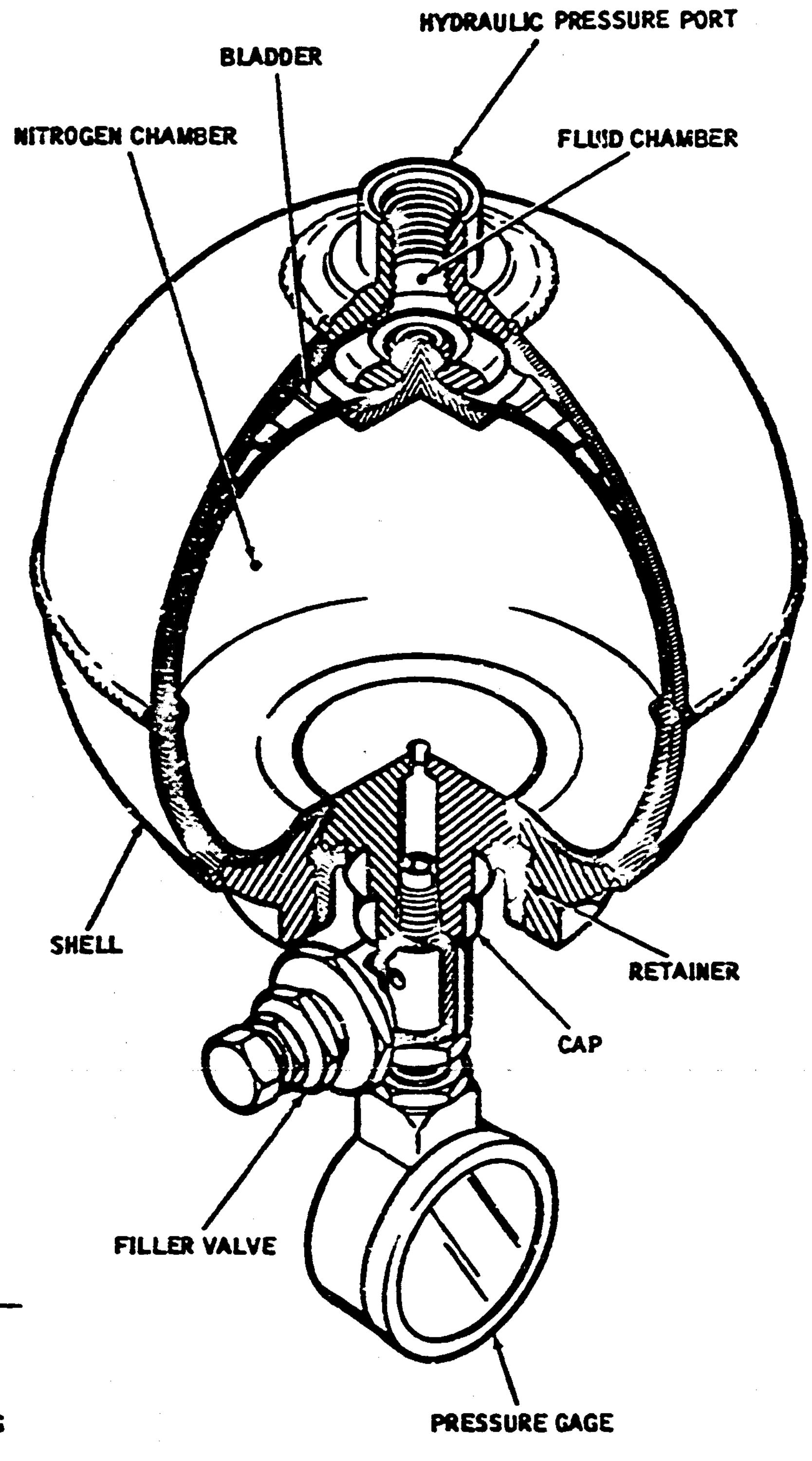
S. Hydraulic Power System Accumulator (See Figure 20.)

(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for the system pressure surges.

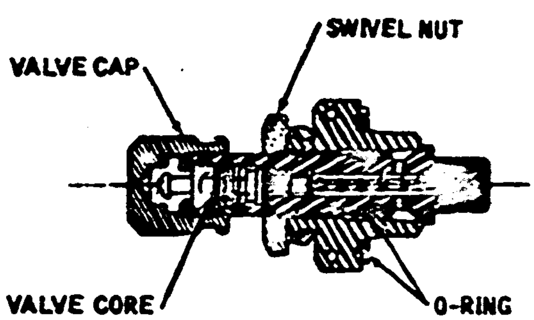
(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.



LEFT MAIN GEAR
WHEEL WELL



VIEW A



FILLER VALVE

HA2-30

Hydraulic Power System Accumulator --
Cutaway View
Figure 20

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

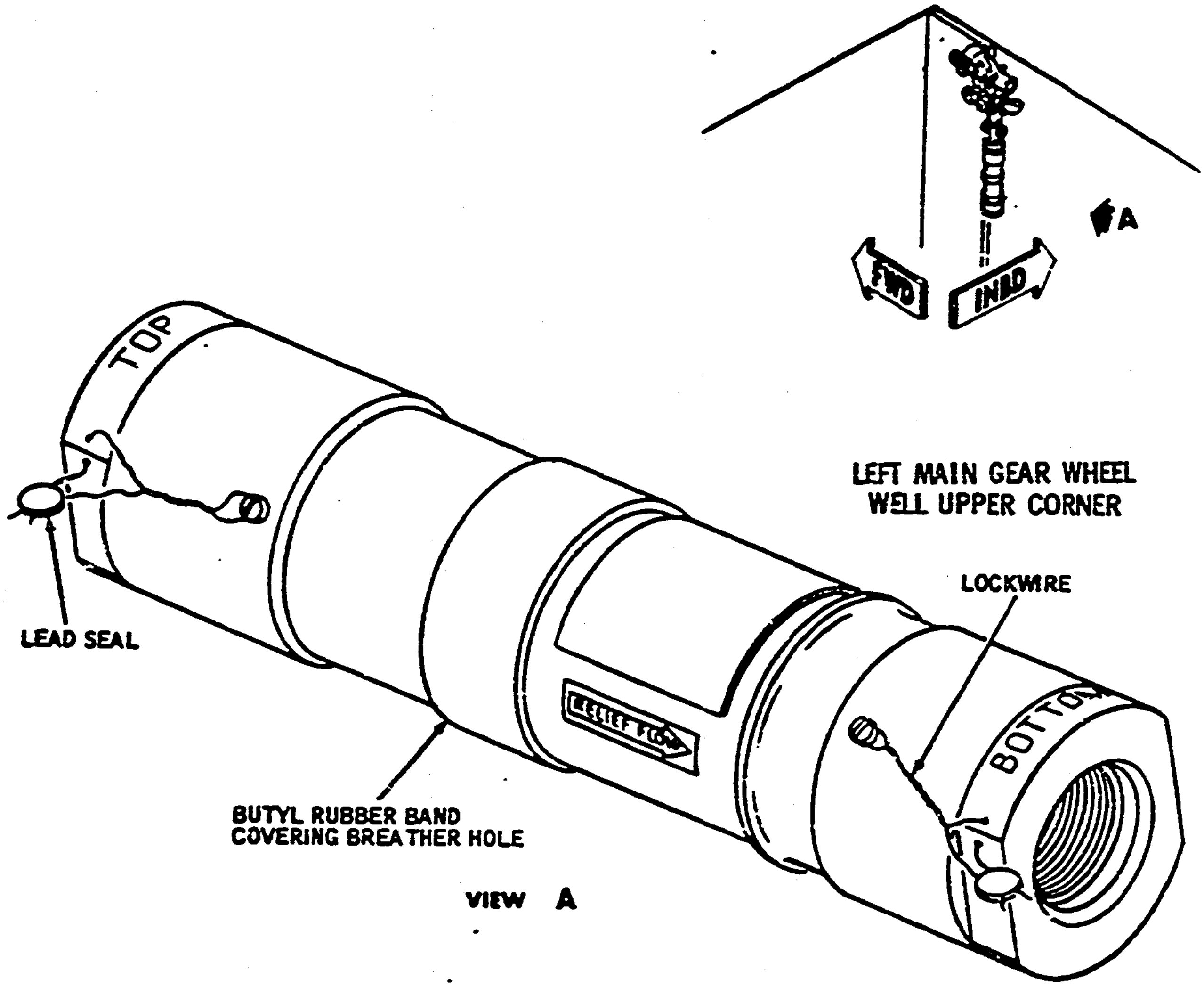
T. Hydraulic System Priority Valve (See Figure 21.)

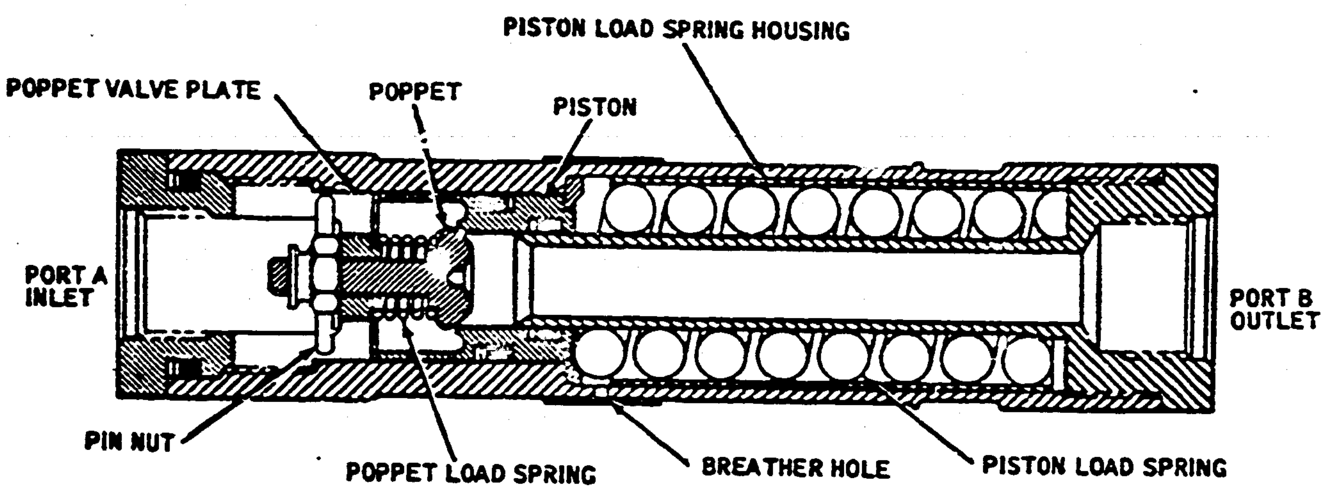
(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring; a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hold which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 psi maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.





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Hydraulic System Priority Valve -- Cutaway View
Figure 21

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10-12 seconds)

(b) Gear extension -- 14 gpm (10-12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/flaps only position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the

sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - DESCRIPTION AND OPERATION

1. General

A. Description (See Figures 1 and 2.)

(1) The hydraulic power system receives fluid pressure from the engine-driven hydraulic pumps, one installed on each inboard engine. The electrically driven auxiliary pump is used to supplement the engine-driven pumps, or to independently supply the system with fluid pressure.

(2) The hydraulic system reservoir, located in the left wing root, has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir is used for fluid, and 1/10 is used for foam space. A separate air chamber is installed in the reservoir system to provide for a greater fluid capacity in the main reservoir. A reservoir filler assembly is installed in the piping between the reservoir and the air chamber and has a vent line from the filler neck to the tee at the top of the reservoir sight gage. The reservoir is pressurized to 30 to 35 psi by bleed pressure from the engine-driven pumps through an air pressure regulator-aspirator.

(3) The engine-driven pumps receive fluid from the pressurized main reservoir through respective engine hydraulic fire shutoff valves. The engine hydraulic fire shutoff valves are normally open and can be mechanically controlled from the flight compartment. The pumps supply fluid pressure through respective check valves to the dual filter and relief valve. Some of the fluid from the filter is ported through the regulator-aspirator to pressurize the reservoir. Most of the fluid is routed through a check valve to the system selector valve, and then to the left and right hydraulic power manifolds. The manifolds distribute the fluid pressure to the subsystems.

(4) Hydraulic fluid is normally supplied to the auxiliary hydraulic pump from a low standpipe in the main reservoir. During alternate operation, the auxiliary hydraulic pump receives fluid supply from the auxiliary pump alternate reservoir, which is located just aft of the auxiliary pump. From these reservoirs, the fluid is ported through the auxiliary pump selector valve which is mechanically controlled from the flight compartment by the system selector control lever. When operating, the auxiliary hydraulic pump supplies fluid pressure to the subsystems through the system selector valve which is also controlled by the system selector control lever in the flight compartment. A filter and check valve are installed in the line from the auxiliary pump to the system selector valve.

(5) An accumulator is installed in the pressure line to the subsystems to provide a reserve supply of fluid and to act as a surge damper for the system

(6) Engine-driven pump fluid pressure is routed through the system selector valve to the left power manifold, where it is distributed to some of the subsystems and through the priority valve to the right power manifold. Fluid pressure from the right power manifold is distributed to the remaining subsystems.

(7) The priority valve is a spring-loaded, poppet-type, balanced relief valve installed in the line downstream of the left power manifold. The priority valve's function in the system is to prevent the flight control systems from reverting to manual operation during high demands on the hydraulic system.

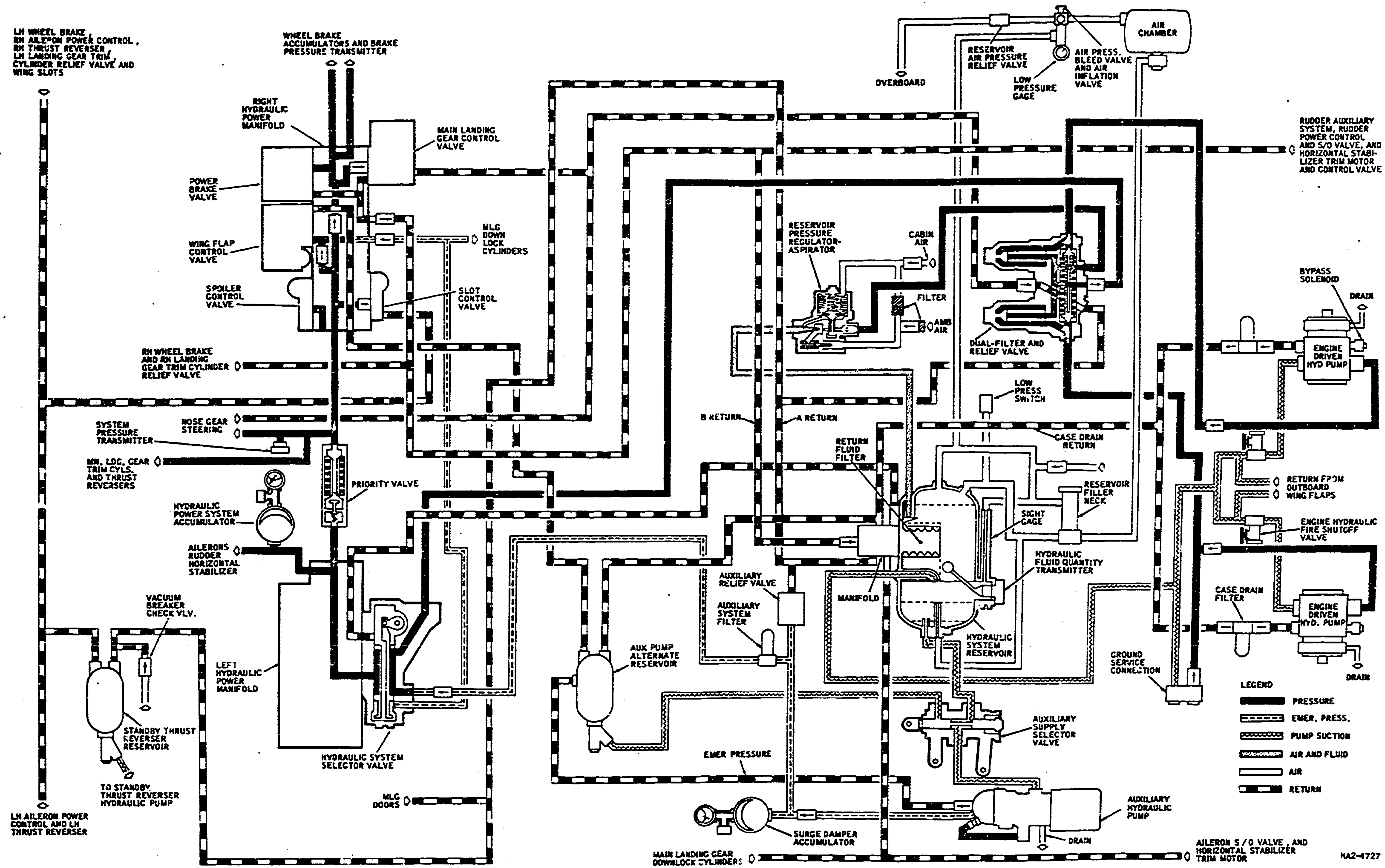
(8) A fluid pressure transmitter, located in the nosewheel well, senses the system pressure, which is indicated on the hydraulic system pressure indicator in the flight compartment.

B. Normal Operation

(1) Fluid is supplied to the hydraulic system from the pressurized hydraulic system reservoir. For operation of the hydraulic system under normal conditions, 8.1 US gallons (6.7 Imperial gallons; 30.6 liters) of hydraulic fluid are available to the engine-driven hydraulic pumps, and 12.9 US gallons (10.7 Imperial gallons; 48.8 liters) are available to the auxiliary hydraulic pump. Supply lines from the main reservoir carry fluid to each inboard pylon through normally open engine hydraulic fire shutoff valves to the engine-driven hydraulic pumps. Fluid is supplied to the auxiliary hydraulic pump from the main reservoir through a low standpipe at the base of the reservoir. Fluid is carried from the reservoir through the auxiliary pump selector valve to the auxiliary hydraulic pump.

(2) The engine-driven hydraulic pumps supply full system pressure (3000 psi nominal) at any given engine speed, from idle to full power. The output flow of the pump is varied by sensing pressure from the outlet side of the pump. Each engine-driven pump contains a solenoid-operated bypass valve which, when energized, bypasses the pressure control regulator of the pump and ports fluid to the pump yoke control piston which feathers the pump. When the pump is feathered, flow rate is reduced to almost zero (1.0 gpm) and to a pressure of approximately 300 psi. Half of this flow maintains pump lubrication and cooling through internal leakage. This leakage is returned, through a check valve, the engine-driven pump case drain line filter, and another check valve to the case drain return port of the reservoir. The pressure fluid from each pump passes through a check valve to the dual filter and relief valve.

(3) The fluid enters the dual filter and relief valve through the relief valve chamber. The fluid is passed through the filter element, through a manifold, and through a common outlet port. Fluid from the outlet port is routed through a check valve to the system selector valve. If back pressure in the system builds up to approximately



Hydraulic Power System - - Schematic Diagram
Figure 1

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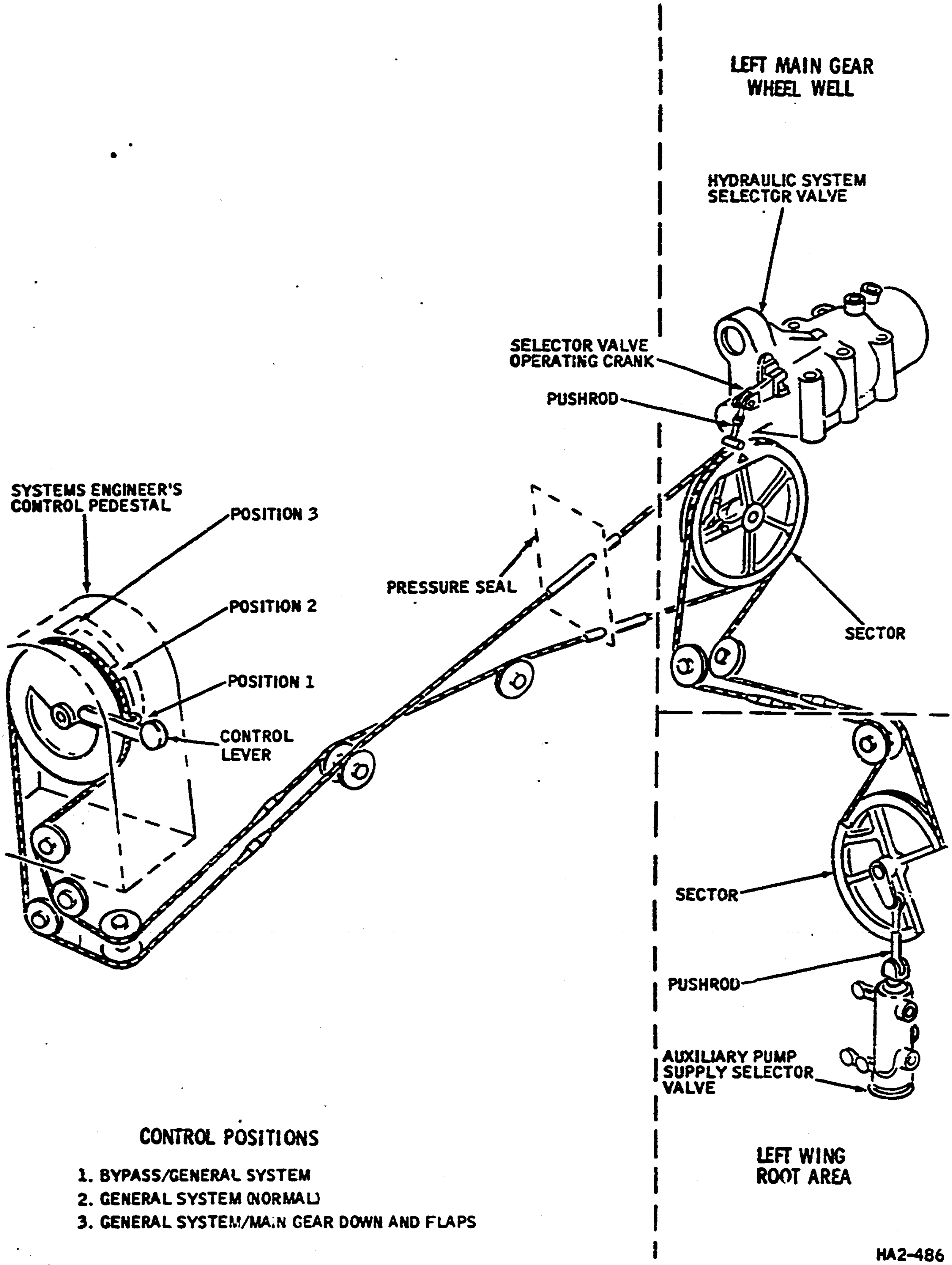


Hydraulic System Selector and Auxiliary Pump Supply
Selector Valves -- Mechanical Control Schematic
Figure 2

3300 psi, the relief valves in the dual filter and relief valve open and port fluid back to the reservoir via a return port. The relief valve poppet closes again when system pressure drops to approximately 3000 psi.

(4) The aspirator receives filtered fluid (bleed pressure at nominal 3000 psi) from the dual filter and relief valve. The aspirator operates on the jet pump principle. Hydraulic fluid is atomized and mixed with air within the unit by a nozzle and a venturi. The mixture is used to pressurize the reservoir and reservoir air chamber. The regulator diaphragm maintains a pressure range of 30 to 35 psi in the reservoir and air chamber. If there is a regulator malfunction, the aspirator stalls when the outlet pressure reaches a maximum of 40 psi. A reservoir relief valve in the reservoir vent line relieves thermal expansion pressure above 45 (+5, -0) psi.

(5) Pump pressure fluid enters the system selector valve through the system pressure inlet port. When the pump selector control lever is in the general system (normal) position, fluid is ported to the pressure passages of the left power manifold. The fluid pressure in the left power manifold is ported through the priority valve to the nose gear and the right power manifold and directly to the following valves:

(a) Aileron power shutoff

(b) Rudder power shutoff

(c) Longitudinal trim hydraulic motor shutoff

(6) The right power manifold distributes fluid pressure to the brake accumulators, the pressure transmitter, and the following control valves:

(a) Wing flap

(b) Slot

(c) Main gear

(d) Power brake

(7) The return fluid from the wing flap control valve is ported through the right power manifold and into the auxiliary hydraulic pump alternate reservoir. Return fluid from the outboard wing flaps is piped into the suction lines for each engine-driven hydraulic pump. Return fluid from the slot control valve is ported into the A return line to the main reservoir. The power brake and main gear control valve gear up return fluid is ported through a restrictor check valve into the B return line to the reservoir. The main gear control valve gear down return pressure bypasses the right manifold and returns to the reservoir through the A return line. All return fluid entering the

reservoir is filtered through the return ports filter located within the reservoir.

C. Bypass Operation

(1) The output of the engine-driven hydraulic pumps is bypassed by moving the system selector control lever out of the general system (normal) position to the bypass/general system position.

(2) The system selector valve in the bypass position ports engine-driven pump pressure from the dual filter and relief valve directly to the return passage of the left power manifold. From the manifold the fluid is ported directly to a tee in the wing flap return port of the hydraulic system reservoir. In the bypass condition, the auxiliary hydraulic pump receives fluid from the hydraulic system reservoir, pressurizes it to system pressure and ports it to the left and right power manifolds for distribution to the subsystems.

D. Alternate Operation

(1) When both engine-driven hydraulic pumps and the auxiliary hydraulic pump are rendered inoperative due to the loss of the normal supply of fluid, the hydraulic power system can be rigged for alternate operation. This is accomplished by placing the system selector control lever in the general system/main gear downlock and flaps position. When the system selector control lever is in this position, the auxiliary hydraulic pump supply selector valve is positioned to supply fluid from the auxiliary pump alternate reservoir to the auxiliary pump.

(2) Fluid is supplied to the auxiliary pump from the outlet port of the auxiliary pump supply selector valve. Output pressure is ported through the auxiliary system filter and check valve to the auxiliary pressure inlet port of the system selector valve.

(3) In the general system/main gear downlock and flaps position, auxiliary pressure bypasses the manifold pressure passages and is ported from the alternate outlet port of the system selector valve. Fluid from this port flows directly to a port on the right power manifold, through an internal check valve in the manifold, to the wing flap control valve.

E. Mechanical Control

(1) The hydraulic power mechanical control system consists of the hydraulic system selector control lever cable drum, the system selector valve sector, the system selector valve, the auxiliary hydraulic pump supply selector valve sector, and the auxiliary hydraulic pump supply selector valve.

(2) The control lever located on the system engineer's control pedestal is used to position the system selector valve and, in turn, the auxiliary hydraulic pump supply selector valve.

(3) The control lever is spring loaded into general system (normal) position, and is connected to the control lever cable drum. Two cables run from the drum, under the cabin floor, aft through the pressure bulkhead at the rear wing spar, and into the left wheel well to the system selector valve sector. A pushrod connects the sector to the positioning lever of the system selector valve.

(4) A second set of cables is routed from the system selector valve sector into the left wing root to the auxiliary hydraulic pump supply selector valve sector. When the system selector valve is in either bypass or normal, the auxiliary hydraulic pump supply selector valve sector is arranged so that the pushrod idles between the two positions. This allows the valve to remain in the auxiliary position. When the sector is moved to the alternate position, the pushrod is pulled by the sector to reposition the valve to the alternate position.

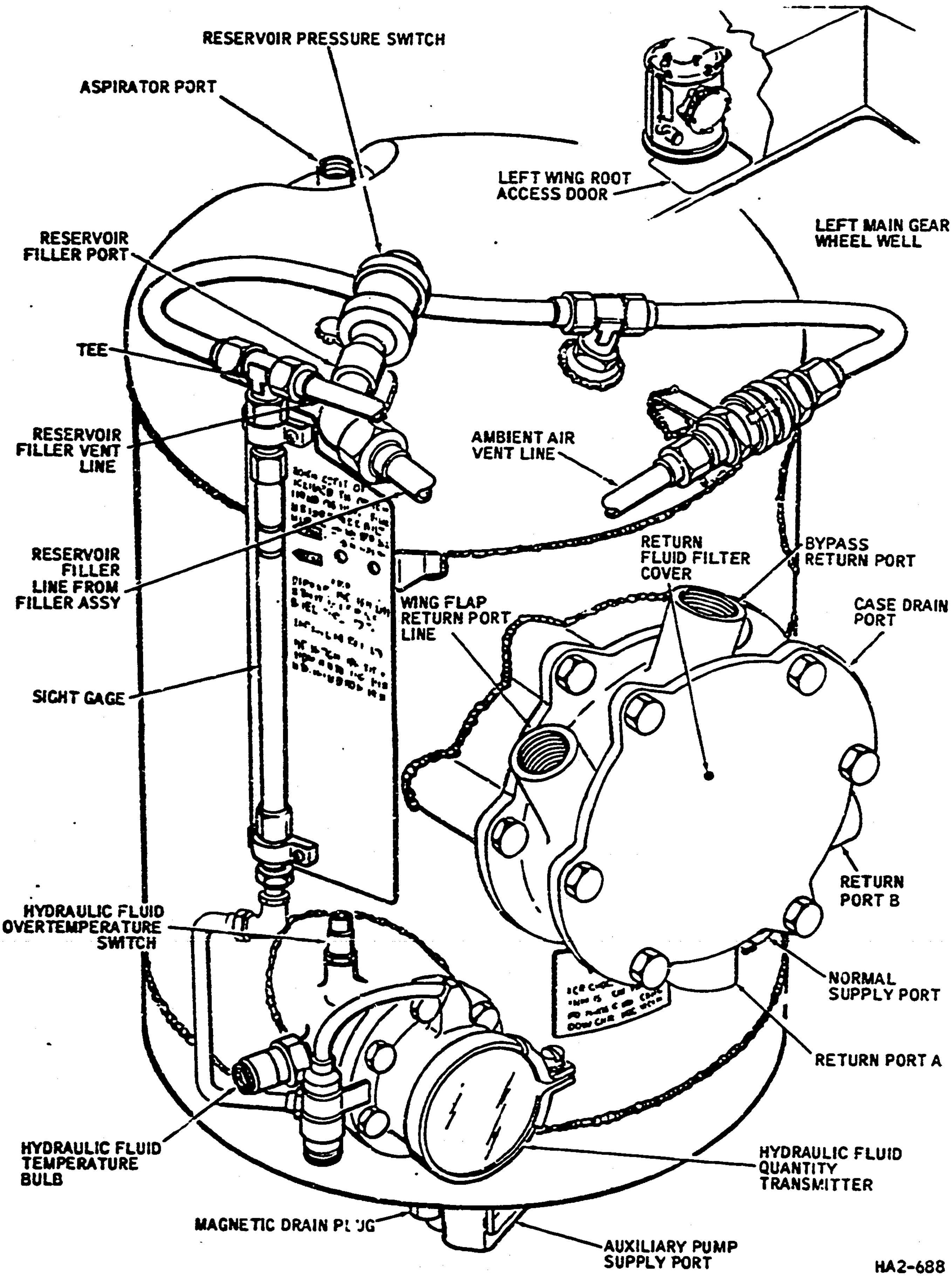
(5) The control lever is normally in the general system (normal) position. To move the system selector valve to the bypass position, the control lever is moved to the bypass/general system position. When the system selector valve is moved to the bypass position, the auxiliary hydraulic pump supply selector valve sector is moved to a new position. Due to the idle feature on the auxiliary sector, the valve remains in the auxiliary position. With the valve in this position, fluid is supplied to the auxiliary pump through the low standpipe in the hydraulic system reservoir. In this condition, engine-driven pump pressure is ported to the reservoir and the auxiliary pump pressure is ported to the general system.

(6) To put the system in alternate operation, the control is moved to the general system/main gear downlock and flaps position. This moves the system selector valve to the alternate position, and simultaneously moves the auxiliary hydraulic pump supply selector valve to the alternate position. Fluid is supplied to the auxiliary pump from the auxiliary hydraulic pump alternate reservoir. Fluid pressure from the auxiliary pump is ported to the flap system control valve and the main gear downlock cylinders. Engine-driven pump pressure is ported from the system selector valve to the general system.

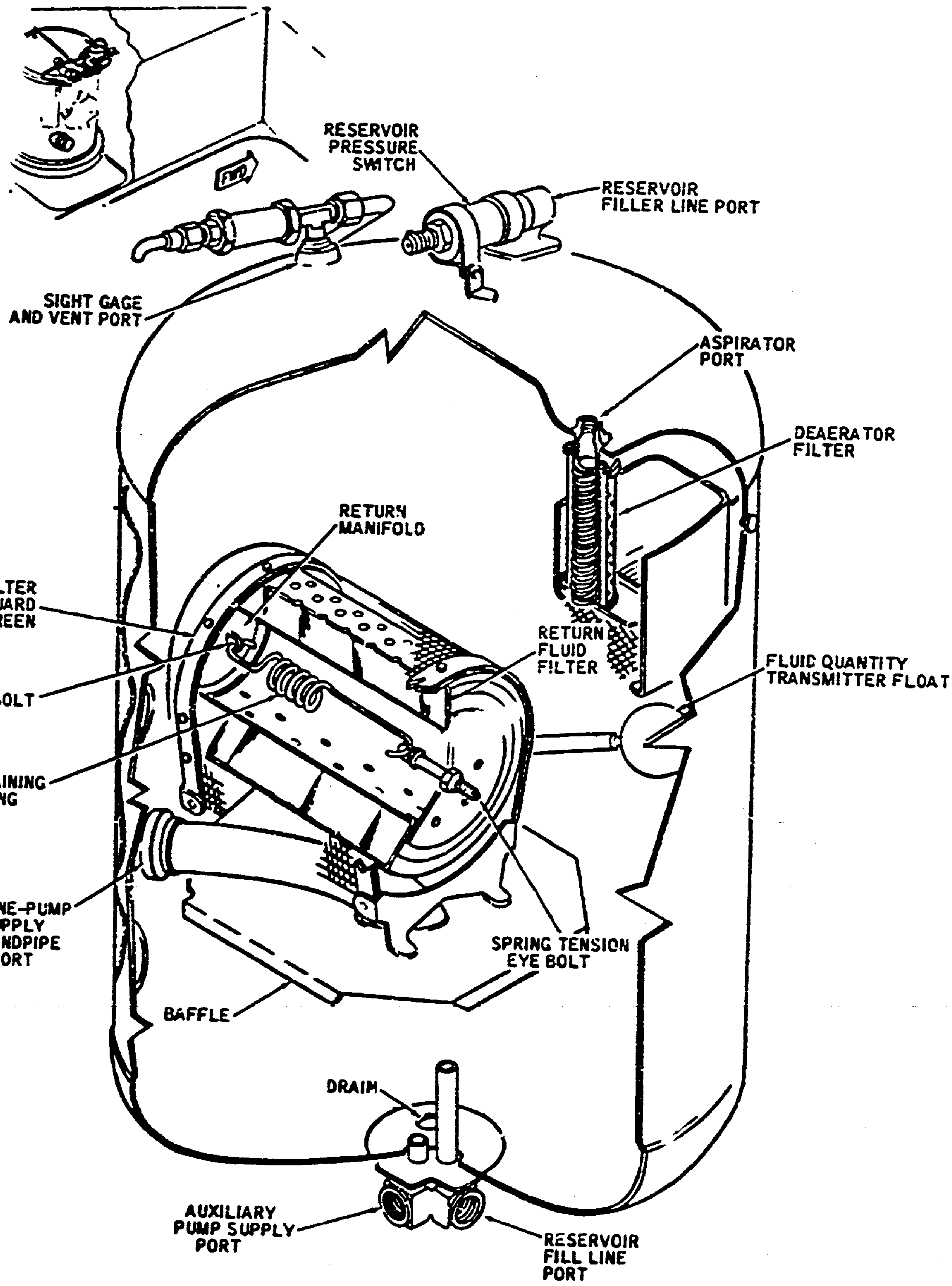
2. System Components

A. Hydraulic System Reservoir (See Figures 3 and 4.)

(1) The hydraulic system reservoir is installed on the aft side of the wing spar in the left wing root and is accessible through the left wing root access door. The hydraulic system reservoir serves as the main source of hydraulic fluid for the engine-driven hydraulic pumps and the normal



Hydraulic System Reservoir -- External View
Figure 3



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Hydraulic System Reservoir -- Cutaway View
Figure 4

supply for the auxiliary hydraulic pump. The reservoir is cylindrical in shape and contains a filter, baffle, and a screen cover encasing the filter. The filter prevents foreign particles from contaminating the fluid supply. Mountings are provided on the exterior surface of the reservoir for return line ports, aspirator port, electrical sensing units, sight gage, instruction placards, magnetic drain plug, and system supply ports.

(2) The reservoir is pressurized with air from the regulator-aspirator to a range of 30 to 35 psi and has a total volume of approximately 14.4 US gallons (11.9 Imperial gallons; 54.5 liters). Approximately 9/10 of the reservoir volume is used for fluid and 1/10 is used for foam space.

(3) The aspirator port through which the reservoir is pressurized is located in the recess on top of the reservoir. An aspirator-deaerator filter is supported in the reservoir by a screen and support box assembly which is mounted to the reservoir wall by two bolts.

(4) The mounting flange for the return ports manifold is welded to the inboard side of the reservoir. The return ports manifold is an open-centered ring, flanged at both sides and provided with five fluid ports around its circumference; return port A is located at the bottom, return port B is located at the lower right side, the wing flap return port is located at the upper left side, and the system selector valve bypass port is located at the top. One flange of the manifold is mounted with six bolts to the mounting flange on the reservoir. The return fluid filter cover fits into the open side of the manifold, and is attached to the outer manifold flange with six bolts to form a fluid-tight cover for both the manifold and the filter.

(5) The return fluid filter is installed in the reservoir, behind the return ports manifold. A retaining spring attached to an eyebolt on the inner side of the return fluid filter cover holds the filter in position. A baffle plate is welded to the inside of the reservoir opening and to the engine pump supply standpipe within the reservoir. A screen that reduces aeration of the fluid is snap-mounted to two brackets that are welded to the baffle. The screen is U-shaped and is mounted so that it encloses the filter.

(6) A flanged adapter for the fluid quantity transmitter is welded to the reservoir below and to the left of the return ports manifold. The adapter is provided with two small port bosses for the hydraulic fluid temperature bulb and the hydraulic fluid overtemperature switch. The lower end of the sight gage connects to a third port in the adapter, while the top of the sight gage tees into a port at the top of the reservoir. An instruction plate is mounted behind the sight gage and the vacuum breaker check valve tees into the port at the top of the reservoir that is used by the sight gage.

B. Hydraulic Reservoir Return Fluid Filter (See Figure 4.)

(1) The reservoir return fluid filter is installed in the hydraulic reservoir to prevent foreign matter from contaminating the fluid supply. The filter is located behind the return ports manifold, and is spring loaded to act as its own relief valve. Access to the filter is by removing the return fluid filter cover from the return ports manifold by removal of six bolts. The filter is attached by the retaining spring to the cover and is withdrawn from the reservoir when the cover is removed.

(2) Externally, the filter consists of two perforated concentric tubes. The area between the tubes is closed by metal end caps which are bonded to the two tubes. A resilient rubber gasket is bonded to each of the caps. Each gasket must be smooth and flat for proper sealing of the filter. The gaskets act as a static seal and a relief valve seat.

(3) Internally, the filter has a 10-micron, resin-impregnated convoluted paper-type filter element. The area of the filter element is approximately 1960 square inches. The filter is held in place by a retaining spring. One end of the spring is attached to an eyebolt located inside the return port's manifold cover. The spring passes through the center chamber of the filter and is connected to another eyebolt. This eyebolt is secured to a large washer and plate by means of a self-locking nut. The washer seats on the rubber gasket which is bonded to the filter. The fluid enters the center chamber of the filter and passes through the inner tube of the filter to the filter element by means of perforation holes. Foreign matter is filtered out by the filter element, and the fluid leaves the element through perforation holes in the outer tube. When the element becomes saturated with foreign matter, the filter acts as its own relief valve and unseats at 20 to 25 psi above normal return pressure which allows fluid to bypass the filter and enter the reservoir.

C. Hydraulic Reservoir Air Pressure Regulator-Aspirator (See Figure 5.)

(1) The reservoir air pressure regulator-aspirator is a jet-type air pump, regulated by a pressure-sensitive shutoff valve. The unit pressurizes the hydraulic reservoir with air to the operating pressure range of 30 to 35 psi. The regulator-aspirator is located on the top inboard side of the reservoir and is mounted on the reservoir retainer ring. Access to regulator-aspirator is through the left wing root access door.

(2) The regulator-aspirator assembly consists of a main aspirator body and a regulator housing. The main aspirator body has two inlet ports and one outlet port. The ports are permanently identified inlet, outlet, and air inlet. The plug for an air check valve is located near the outlet port. A chemically treated paper filter is installed near the aspirator body air inlet port in the air line from the pressurized

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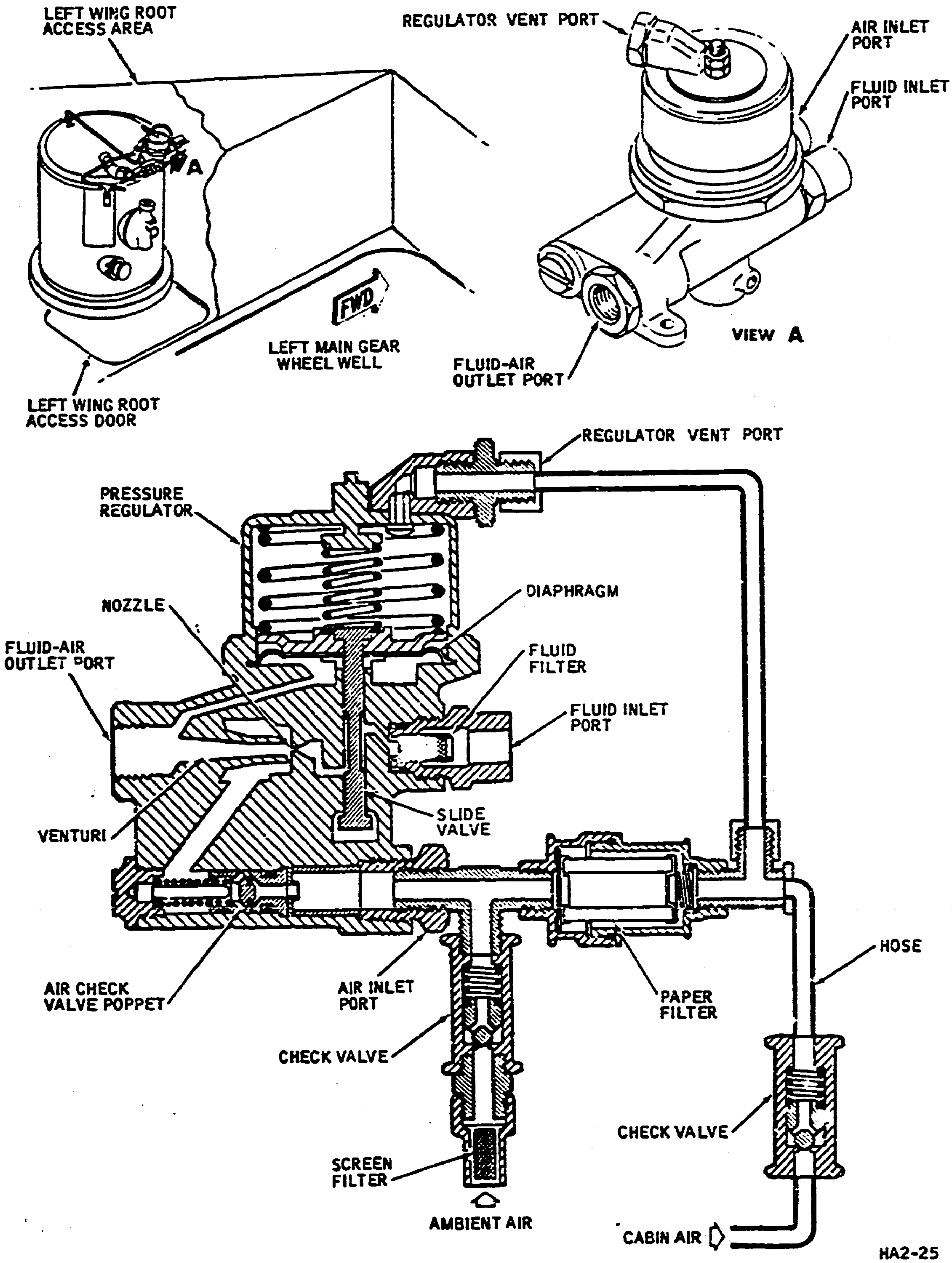


Reservoir Air Pressure Regulator-Aspirator -- Schematic
Figure 5

cabin area. A metal screen filter is installed on the check valve which tees into the aspirator body air inlet port.

(3) The reservoir air pressure regulator-aspirator operates basically with a jet pump action which is regulator controlled. Fluid enters the assembly through the fluid inlet port where it is filtered and then ported through the valve assembly of the regulator. During normal operation, when air pressure at the outlet port is under 30 psi, the valve is open, porting fluid to the nozzle. The orifice in the nozzle sprays the fluid through the venturi of the outlet port, creating a vacuum in the chamber around the venturi. When the vacuum becomes great enough to create a pressure differential of approximately 1 psi, ambient air opens the air check valve. The air is ported to the chamber around the venturi and is siphoned, with the fluid, through the outlet port.

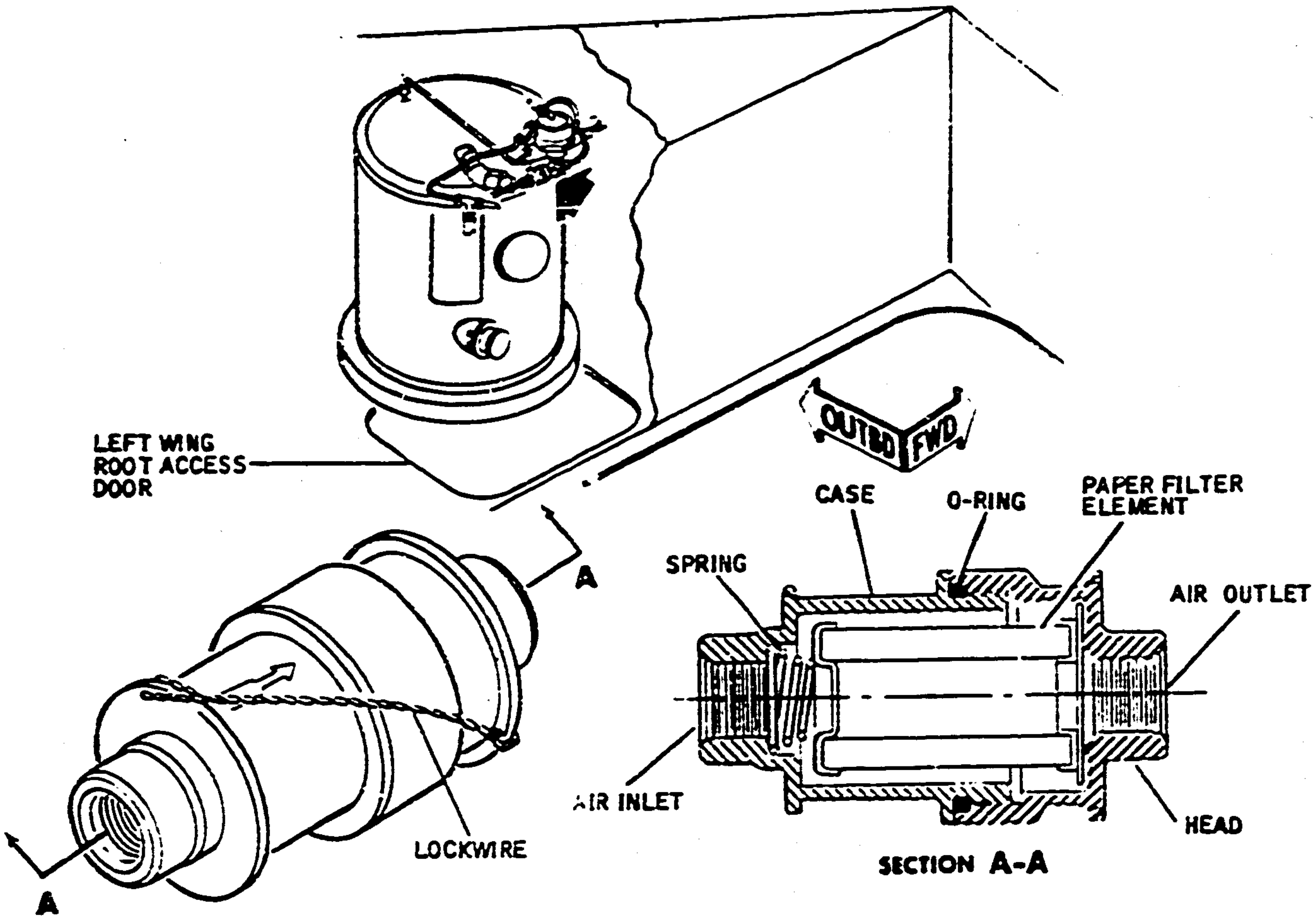
(4) Hydraulic fluid inlet pressure at the engine-driven hydraulic pumps is improved at high altitude operation by supplying pressurized filtered cabin air to the reservoir regulator-aspirator instead of ambient outside air. Part of the inlet air is diverted by a tee fitting to the regulator chamber to provide a more positive regulating force on the diaphragm than would be obtained with low ambient pressures. The chemically treated paper filter, installed in the regulator-aspirator air supply line from the cabin, removes smoke tars and impurities from the pressurized cabin air. The steel mesh screen filter, installed on the check valve which tees into the regulator-aspirator air inlet port downstream of the paper filter, removes dust, dirt, and foreign particles from the ambient air and serves as a standby to supply filtered air in event the paper filter is clogged.

(5) As pressure in the reservoir builds up, back pressure is bled from the outlet port to the disphragm chamber. The reaction on the diaphragm begins to move the slide valve to cut off the fluid flow. At 30 to 35 psi of back pressure, the disphragm completely closes the slide valve, cutting off the flow of fluid. If there is a regulator malfunction, the aspirator stalls when outlet pressure reaches a maximum of 40 psi.

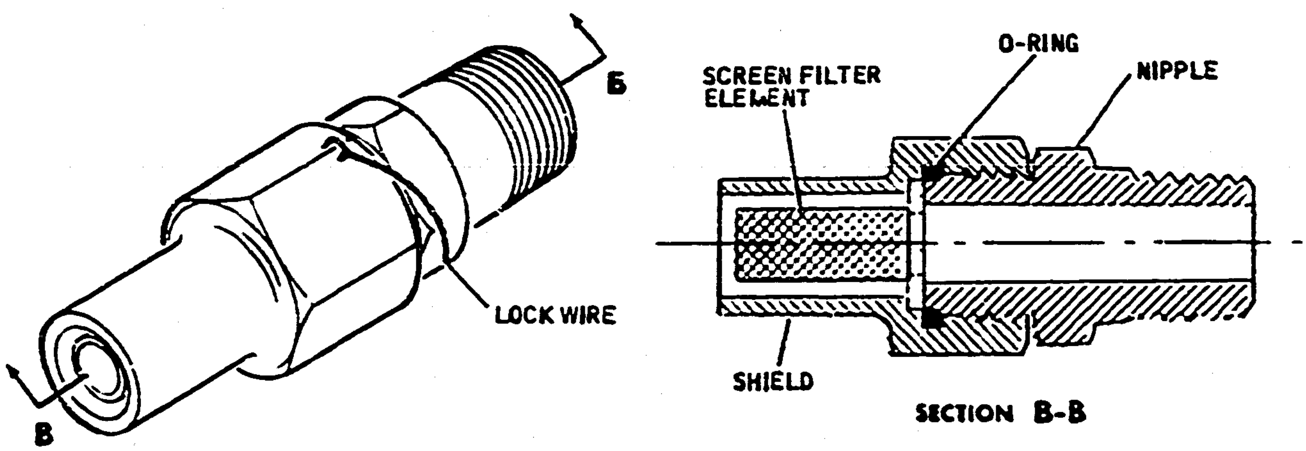
(6) The aspirator is capable of pressurizing the reservoir to 30 to 35 psi in approximately 4 minutes at altitudes from sea level to 15,000 feet, when fluid is ported through the nozzle at 0.5 gpm at 3000 psi.

D. Regulator-Aspirator Air Filters (See Figure 6.)

(1) The regulator-aspirator air filters remove ambient and cabin air impurities from the air which is used to prezzurize the main hydraulic system reservoir. The filtering system is composed of two filters. One of which is a paper element filter, installed directly in the cabin air supply line near the regulator-aspirator. The other filter is a fine mesh, screen-type filter, installed on a check valve and positioned at right angles to the regulator-aspirator air inlet port. The screen filter, in addition to providing an immediate supply of



PAPER ELEMENT FILTER



SCREEN FILTER

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Regulator-Aspirator Air Filters -- Cutaway View
Figure 6

ambient air during ground operations, serves as a standby air inlet to preclude air starvation of the regulator-aspirator in the event the paper element filter becomes clogged.

E. Hydraulic Reservoir Relief Valve (See Figure 7.)

(1) The reservoir relief valve and the air pressure aspirator-regulator keep the reservoir pressurized to normal operating range. The valve relieves excess air pressure which may build up in the reservoir through thermal expansion in the system. The valve has an inlet port and an outlet port and consists, internally, of an inlet port seat and a spring-loaded poppet.

(2) The relief valve is installed in the overboard vent line downstream of the hydraulic reservoir air bleed valve. In the event that excess pressure builds up in the reservoir, the poppet will start to relieve at 45 (+5, -0) psi. Full flow of 10 gpm is attained at 80 psi maximum. The poppet reseats at 90 percent of the opening pressure.

F. Hydraulic Reservoir Air Bleed Valve (See Figure 8.)

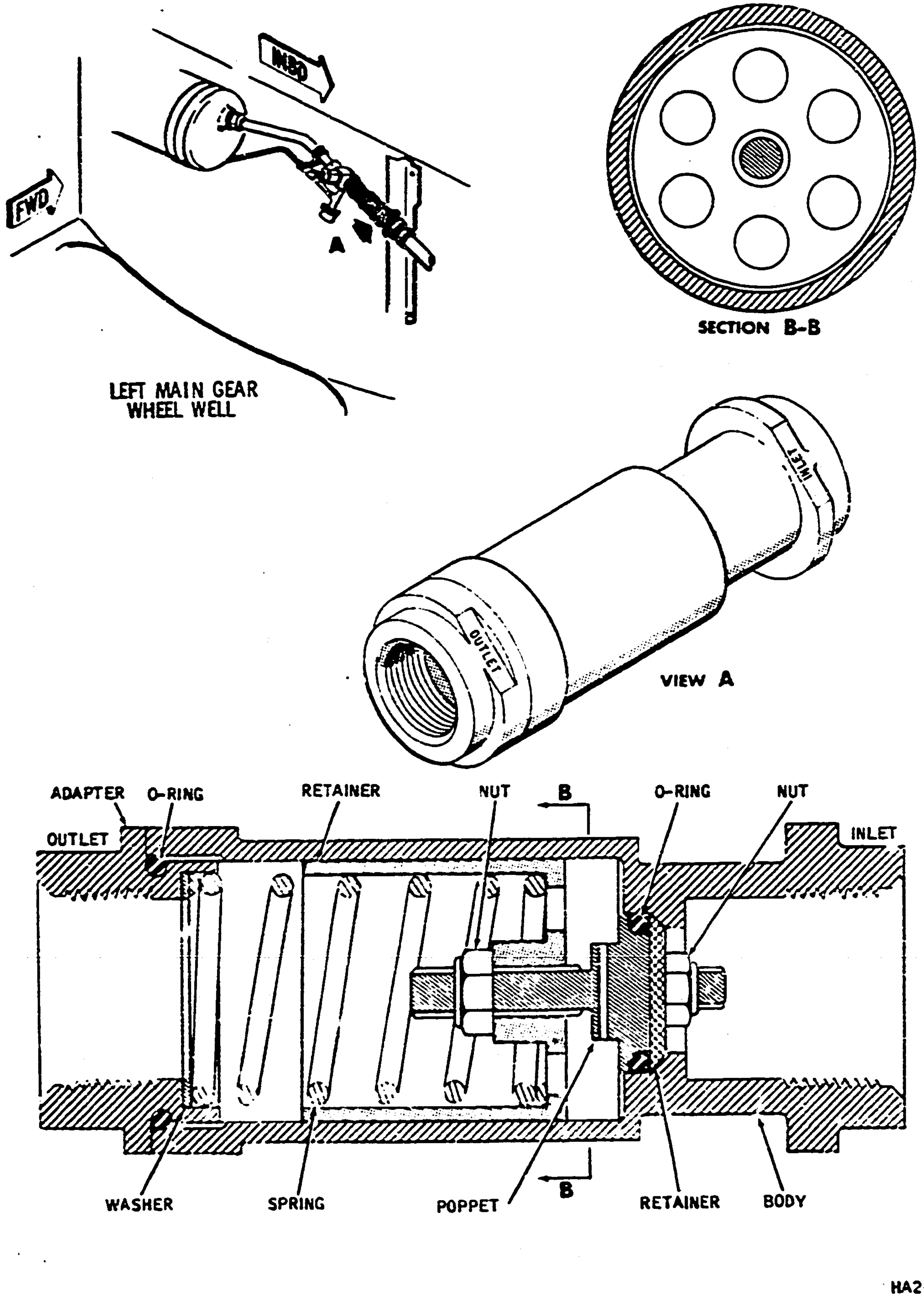
(1) The hydraulic reservoir air bleed valve and pressure gage are located on the aft side of the rear spar in the left main gear wheel well, inboard of the hydraulic reservoir air chamber. The bleed valve and gage are installed in the overboard vent line, between the reservoir air chamber and the reservoir relief valve.

(2) The bleed valve is used to relieve the reservoir air pressure prior to disconnecting lines or components in the hydraulic system. The pressure gage provides a ready indication of the hydraulic reservoir air pressure and is used in conjunction with the bleed valve to indicate the air pressure status.

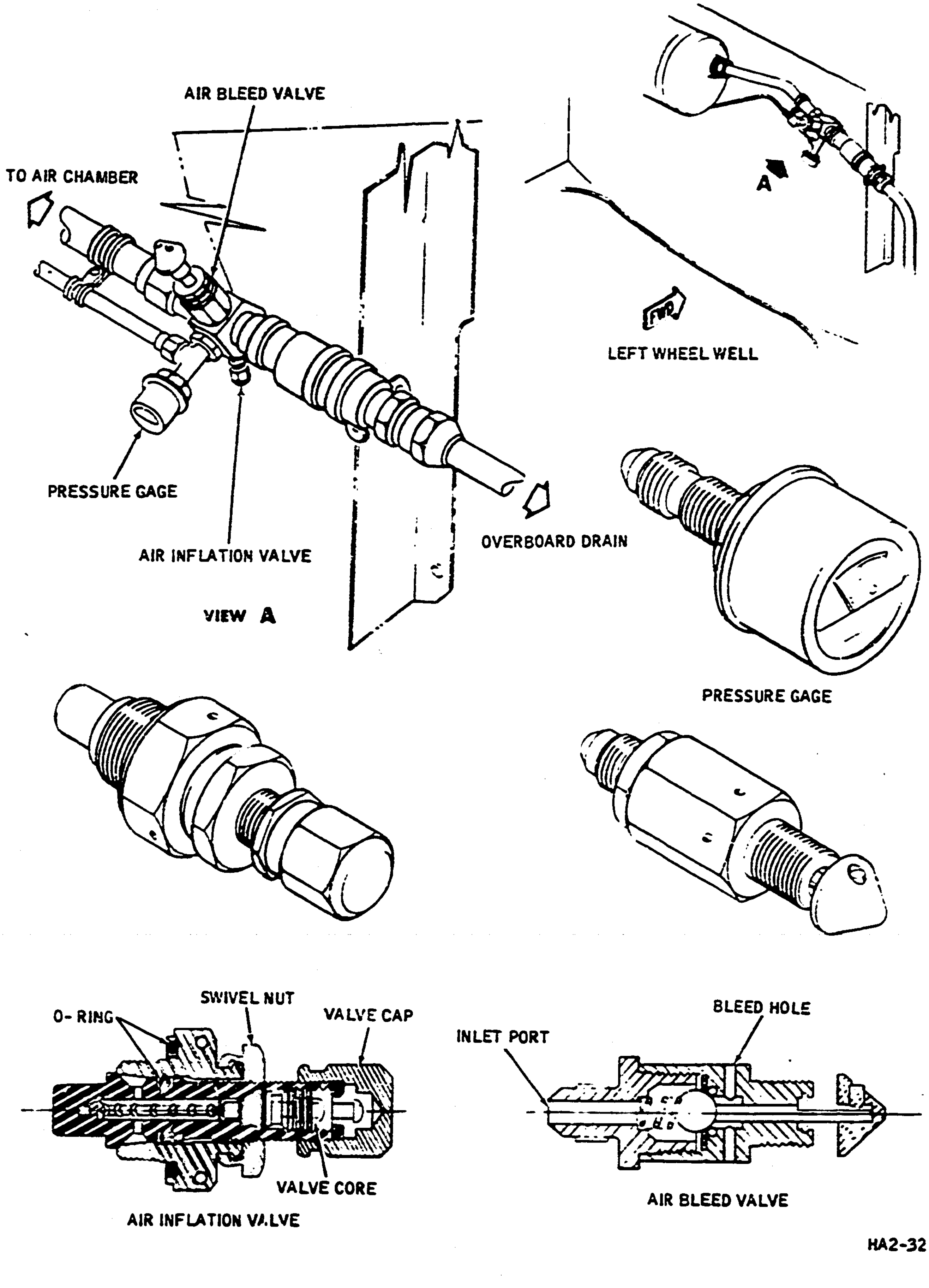
(3) The air inflation valve is installed on the same fitting as the bleed valve and pressure gage. The air inflation valve is used to manually charge the reservoir with air or dry nitrogen.

G. Hydraulic Reservoir Vacuum Breaker Check Valve (See Figure 9.)

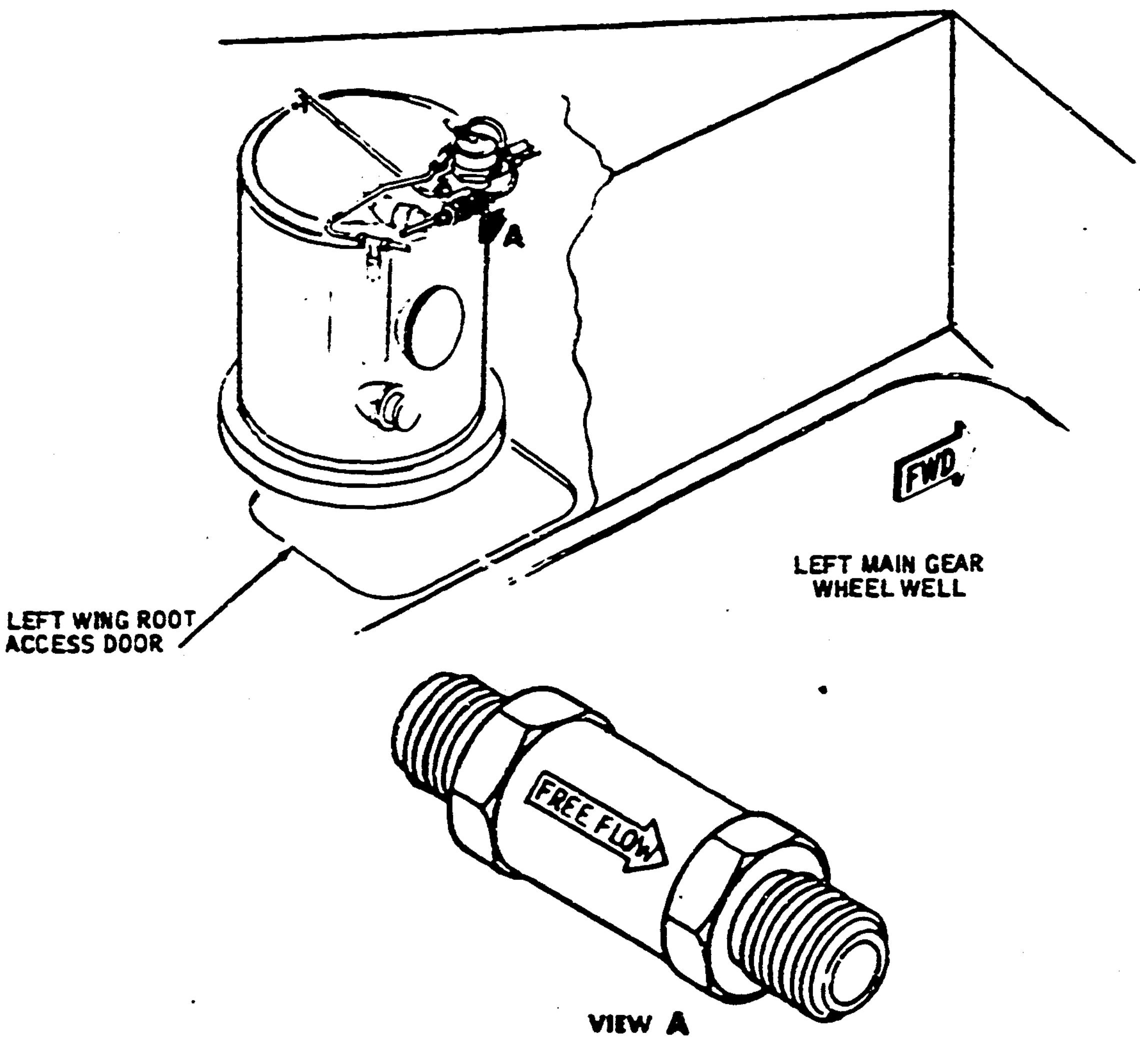
(1) The hydraulic reservoir vacuum breaker check valve is installed on the regulator-aspirator mounting bracket, and connects to the tee fitting at the top of the reservoir. The valve is vented to ambient air. The purpose of this valve is to maintain atmospheric pressure in the reservoir, allowing hydraulic fluid to flow to the auxiliary hydraulic pump in the event of a failure of the reservoir pressurization system. The failure, or breakdown, of the pressurization system could cause a fluid starvation at the auxiliary hydraulic pump because of vacuum buildup in the reservoir.

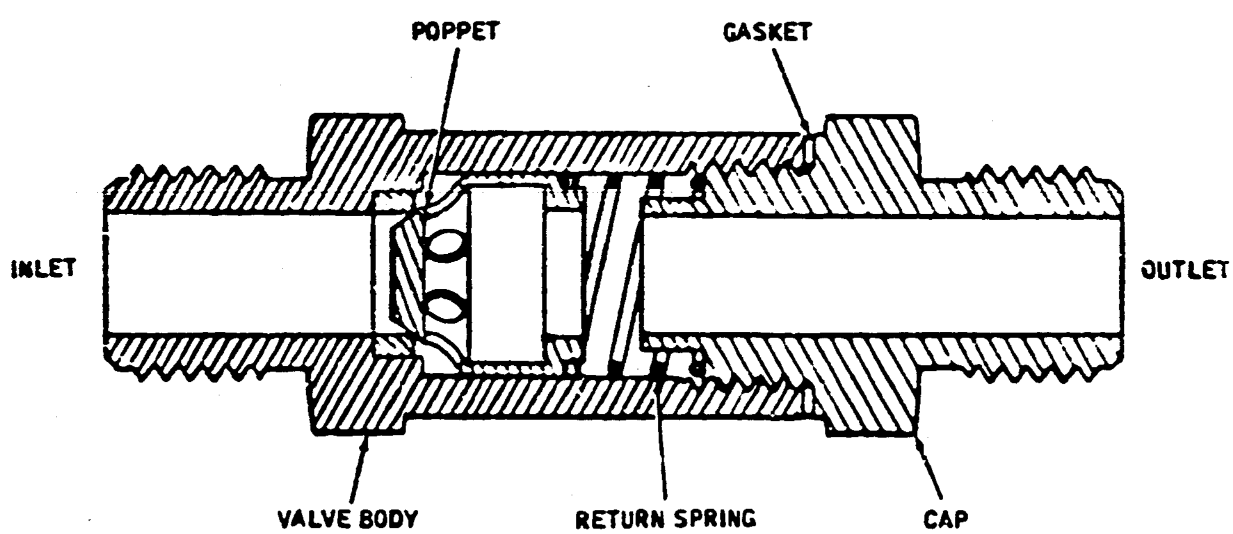


Hydraulic Reservoir Relief Valve
Figure 7



Reservoir Air Bleed Valve, Air Inflation
Valve, and Pressure Gage
Figure 8





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Hydraulic Reservoir Vacuum Breaker Check Valve
Figure 9

H. Hydraulic Reservoir Air Chamber

(1) The hydraulic reservoir air chamber is a small, cylindrical tank with a capacity of 700 cubic inches. It has two ports, an inlet port at the bottom of the chamber and an outlet port in one end of the chamber. The inlet port mounting boss is fitted with a drain plug. The air chamber is installed on the aft side of the rear spar in the left main gear wheel well, inboard and above the hydraulic reservoir filler assembly. Access to the air chamber is through the left main gear inboard door.

(2) The air chamber provides for greater fluid capacity in the hydraulic reservoir by providing air and foam space for the reservoir in a separate container. Air pressure in the chamber is maintained by the regulator-aspirator and the air relief valve. The air pressure in the chamber and reservoir can be relieved, when desired, by the air bleed valve located downstream of the chamber. The air chamber is mounted higher than the reservoir filler assembly, to prevent overfilling of the reservoir from reducing the available air space and to prevent fluid from being vented overboard through the reservoir relief valve.

I. Hydraulic Reservoir Port B Return Check Valve (See Figure 10.)

(1) The reservoir port B return check valve is installed in port B of the reservoir to prevent reverse flow of hydraulic fluid from the reservoir to the return line. The check valve is located on the reservoir in the left wing root and is accessible through the left wing root access door.

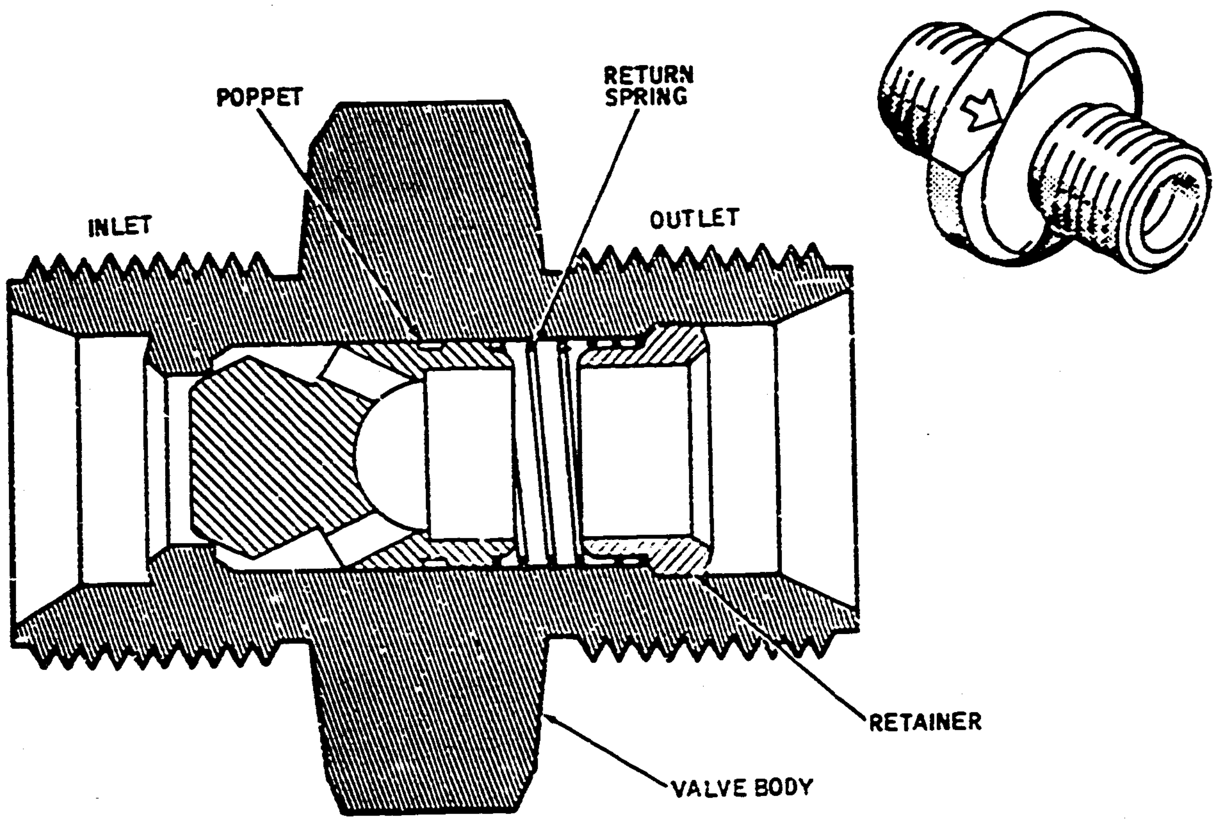
(2) Externally and internally, the port B check valve is a standard-type check valve with a 1500-psi rating. A nominal pressure of approximately 8 psi unseats the poppet, permitting fluid to flow through the valve. When the reservoir pressure exceeds the return line pressure, the poppet will seat and reverse fluid flow will be prevented.

J. Engine Hydraulic Fire Shutoff Valve (See Figures 11 and 12.)

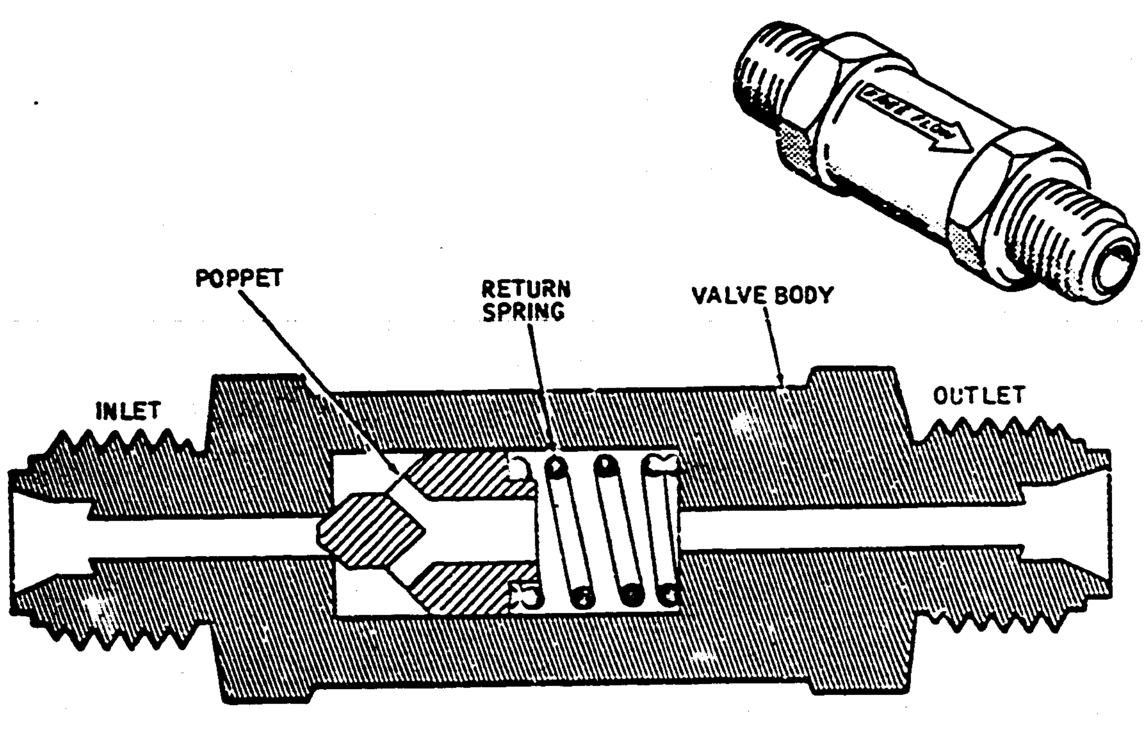
(1) The engine hydraulic fire shutoff valve is a gate-type, mechanically controlled valve, installed in the supply line of each engine-driven hydraulic pump. The engine hydraulic fire shutoff valve is actuated from the flight compartment to prevent the flow of hydraulic fluid into the engine section.

(2) The engine hydraulic fire shutoff valve is mounted on a 2-piece channel bracket which is installed inside the wing leading edge, aft of the firewall of each inboard pylon. Access to the valve is through the access door located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. Each valve is located approximately 30 inches inboard of the access door.

(3) Internally, the valve consists of a valve arm, valve arm link, cam plate, and slide blade. The valve arm link attaches to the valve



MINIATURE CHECK VALVE



STANDARD CHECK VALVE

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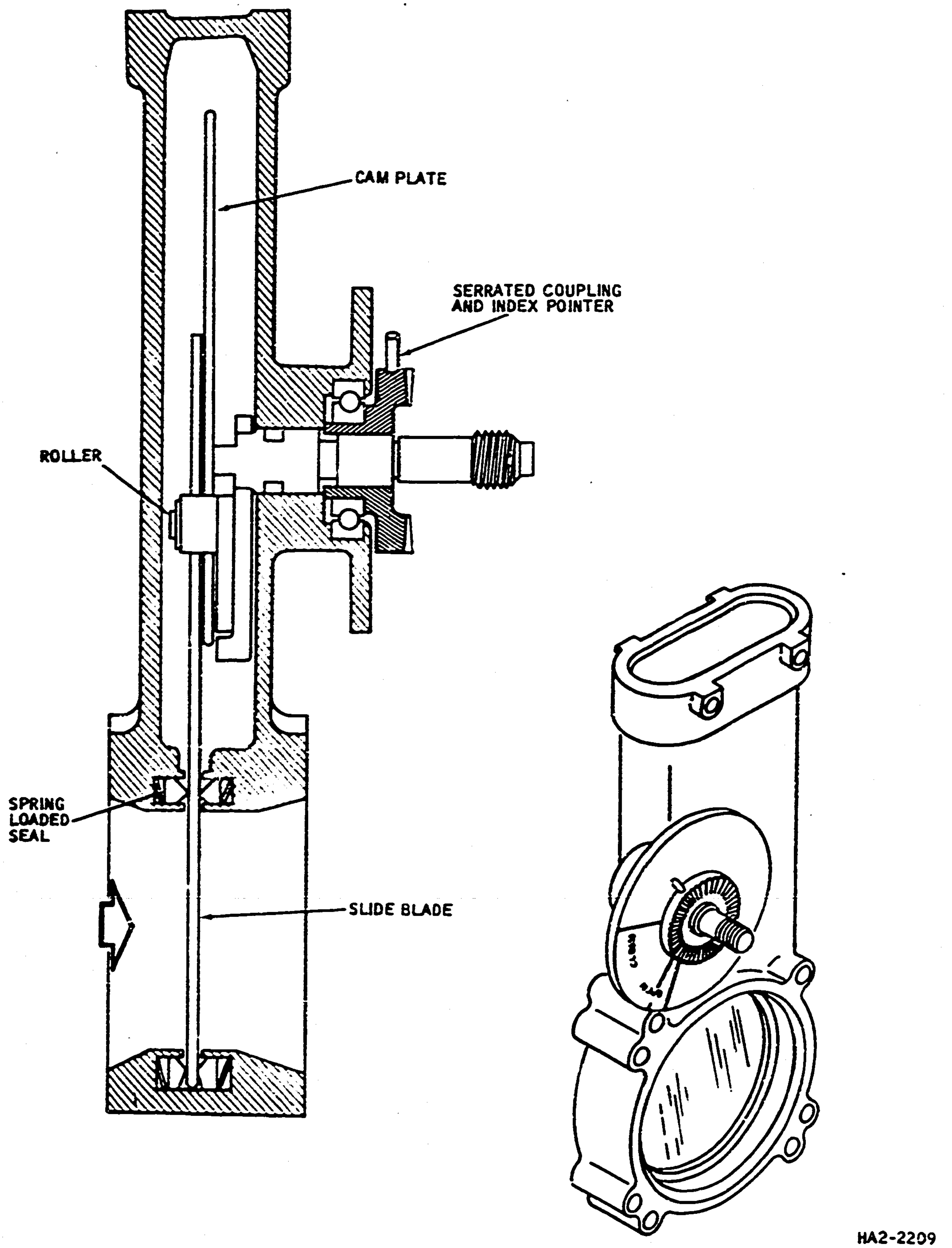
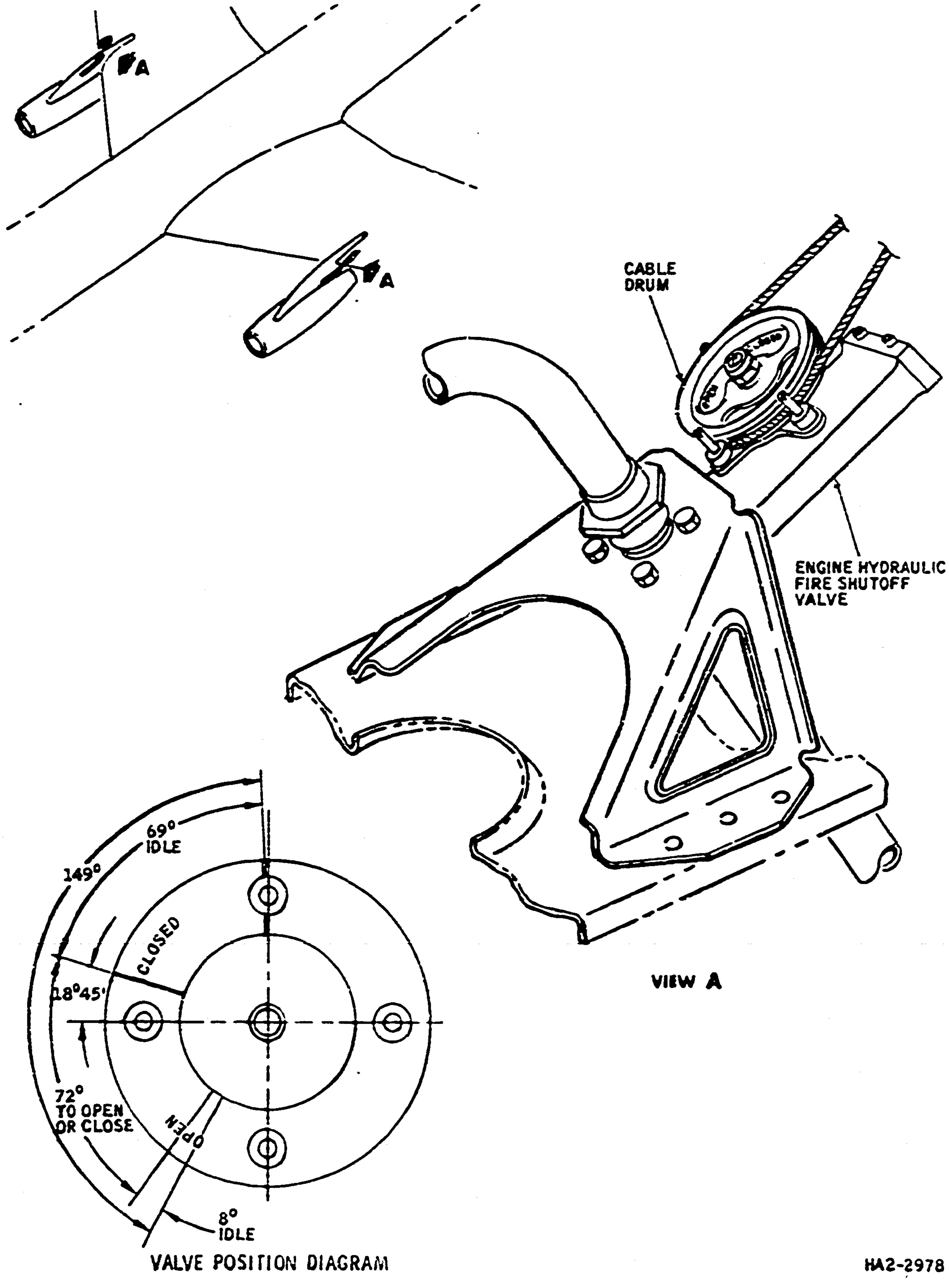
Hydraulic Check Valves -- Typical
Figure 10



Engine Hydraulic Fire Shutoff Valve -- Schematic
Figure 11



Engine Hydraulic Fire Shutoff Valve
Figure 12

arm and is allowed to swivel through an arc in relation to the valve arm. The link has a stop that will contact the arm when the two have traveled to the valve closed, full overtravel position. In the full open pretravel position, the link contacts the arm stop.

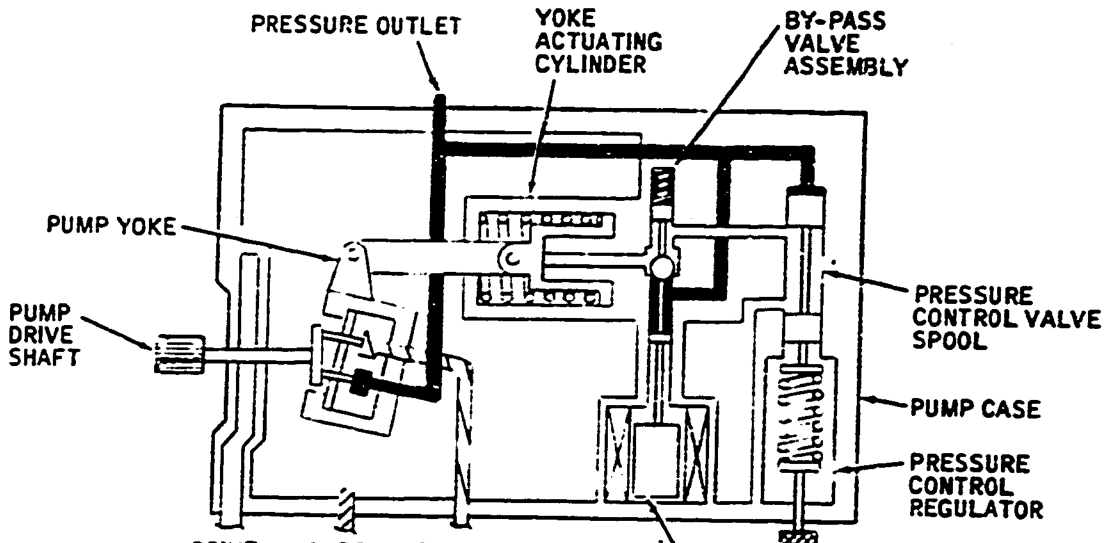
(4) A roller attached to the end of the link rides in, and extends through, a J-shaped slot in the cam plate. The rotation of the valve arm causes the link roller to follow the cam slot, allowing the arm and link to move through independent arcs.

(5) The slide blade (gate of the valve) is slotted near the one end and also receives the link roller extending through the cam slot. The slide blade is positioned parallel to the cam plate and is guided by two grooves in the housing. This will allow the blade to open or close through porting of the valve by the action of the arm and link. The cam plate is pinned to the valve shaft, securing it rigidly in two positioning grooves in the housing. A pin-indicator is provided to relate valve position to a reference plate placarded open and closed.

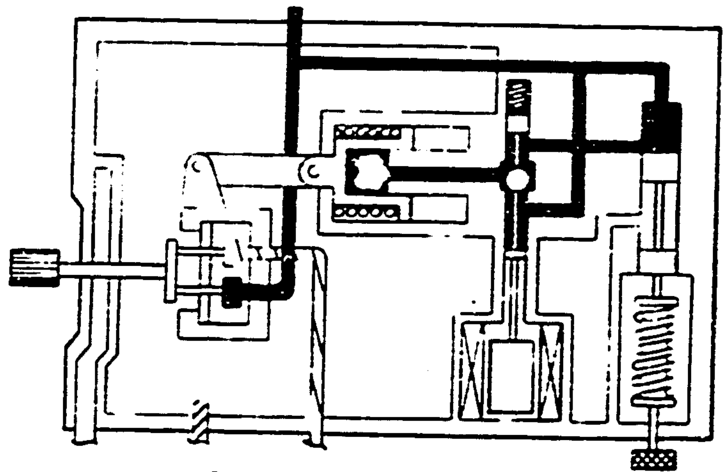
(6) The engine hydraulic fire shutoff valves are cable actuated by the fire control handles, located on the overhead switch panel in the flight compartment. When the fire control handle for either inboard engine is moved, the cable system rotates the drum which is attached to the corresponding shutoff valve shaft. This action extends the valve blade into the fluid passage to block the flow of fluid. The valve operates from open to close by clockwise rotation of the cable drum. The valve gage will idle during the first 8 degrees of rotation of the cable drum, and then will close in the next 72 degrees. The cable drum will continue to rotate the shaft for an additional 69 degrees after the gate valve is closed, locking it overcenter. Total travel of the cable drum is 149 degrees.

K. Engine-Driven Hydraulic Pump (See Figure 13.)

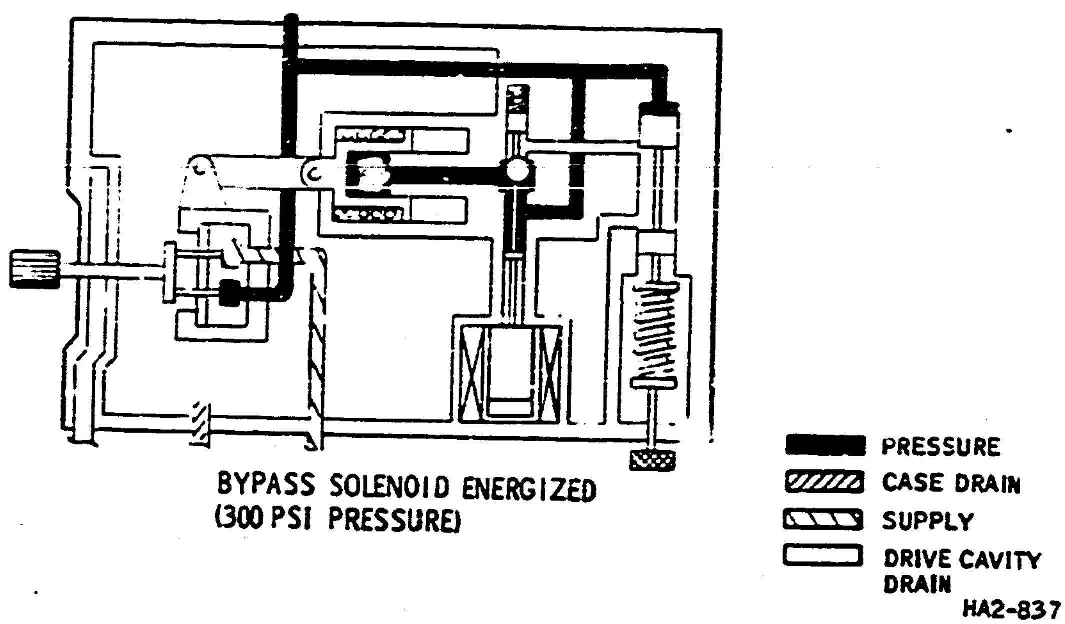
(1) A variable-displacement, pressure-compensated, engine-driven hydraulic pump is installed on each inboard engine. The pump incorporates a solenoid bypass feature for reducing the output of the pump. The bypass valves are controlled by two engine hydraulic pump control switches in the flight compartment. The switch for the hydraulic pump on engine No. 2 is placarded left, on and bypass. The switch for the hydraulic pump on engine No. 3 is placarded right, on and bypass. When either of the two engine hydraulic pump control switches is placed in the bypass position, the bypass valve solenoid for that hydraulic pump is energized and the pump pressure decreases to 300 (±100) psi. When either switch is in the on position, the control circuit to the corresponding bypass valve is open and the hydraulic pump operates normally in the pressure range of 2850 to 3050 psi. The pump provides a continuous, non-pulsating flow of hydraulic fluid, under pressure, to the hydraulic manifolds for distribution throughout the hydraulic system. Each of the engine-driven pumps is located on the accessory drive pad of the inboard engines. These pumps are accessible through the access



MAXIMUM FLOW



COMPENSATOR AT CUTOFF
(MINMUM FLOW, MAXIMUM PRESSURE)



BYPASS SOLENOID ENERGIZED
(300 PSI PRESSURE)

Engine-Driven Hydraulic Pump Pressure
Flow -- Schematic
Figure 13

doors on the right side of the nacelles and removal of the engine bypass duct.

(2) Three case drain ports are provided: two are on the yoke assembly housing, and the third is on the casing for the pressure control valve, adjacent to the inlet port fitting. The case drain port on top of the yoke assembly housing is used as the case drain connection to assure that the pump housing is full of fluid at all times. This drain connection is ported back to the low-pressure return port of the reservoir. The inlet port fitting is on top of the pump housing and the outlet port fitting is opposite to it on the bottom of the housing, and contains a low pressure indicating light switch.

(3) The yoke control piston casing is an integral part of the pump case. Four self-locking nuts are used to hold the piston casing end-plate in position. The bypass valve assembly, consisting of the valve body and a solenoid, is mounted externally on the pump case, under the yoke control piston casing. This solenoid valve is provided with an electrical connector. A pressure control regulator is installed on the bypass valve body by means of four bolts. This regulator is cylindrical and is provided with an external adjustment screw. A lock screw is used to retain the adjusting screw after the adjustment has been made.

(4) Hydraulic fluid enters the pump through an inlet port. Passages in the yoke carry the fluid to the valve plate, which ports the fluid to the cylinder block. The nine pistons in the cylinder block are actuated by the rotating drive shaft, thereby pressurizing the fluid. From the cylinder block, the fluid is routed to the outlet port of the yoke and then to the pump pressure lines. The pressure control regulator is actuated by pump output pressure that is bled to the regulator. The regulators meter the pressure to the yoke control piston, which position the yoke.

(5) The maximum pump pressure is determined by the adjustment of the pressure control regulator. The pressure control regulator allows maximum output flow (22.5 gpm at 3500 rpm) up to 2850 psi system pressure. When this pressure is reached, the yoke assembly starts to move towards the zero flow position.

(6) Pressure continues to rise until the displacement is reduce from maximum flow to zero flow and 3000 psi is reached. If the engine-driven hydraulic pump control switches are in the on position, and the output pressure of either pump drops below 1500 psi, an amber indicating light located in the flight compartment comes on.

L. Engine-Driven Hydraulic Pump Check Valves (See Figure 10.)

(1) Two check valves, rated at 3000 psi, are installed in the lines from each engine-driven hydraulic pump. One check valve is installed in the pressure line and the other is in the case drain line. The check valves in the pump pressure lines prevent reverse flow of hydraulic

fluid through the pump, when the pump is inoperative or when external hydraulic pressure is supplied to the system. Access to the valves can be gained through an access door in the forward right apron of each inboard pylon. The valves are mounted on the exterior wall of the inlet box by means of the bulkhead fittings and retaining nuts.

(2) Normal operating pressure will unseat the poppet, and fluid will flow through the valve. When pressure downstream of the valve exceeds pressure from the pump, the pressure, with the aid of the return spring, will seat the poppet. This prevents reverse flow of hydraulic fluid through the pumps.

M. Engine-Driven Hydraulic Pump Case Drain Filter (See Figure 14.)

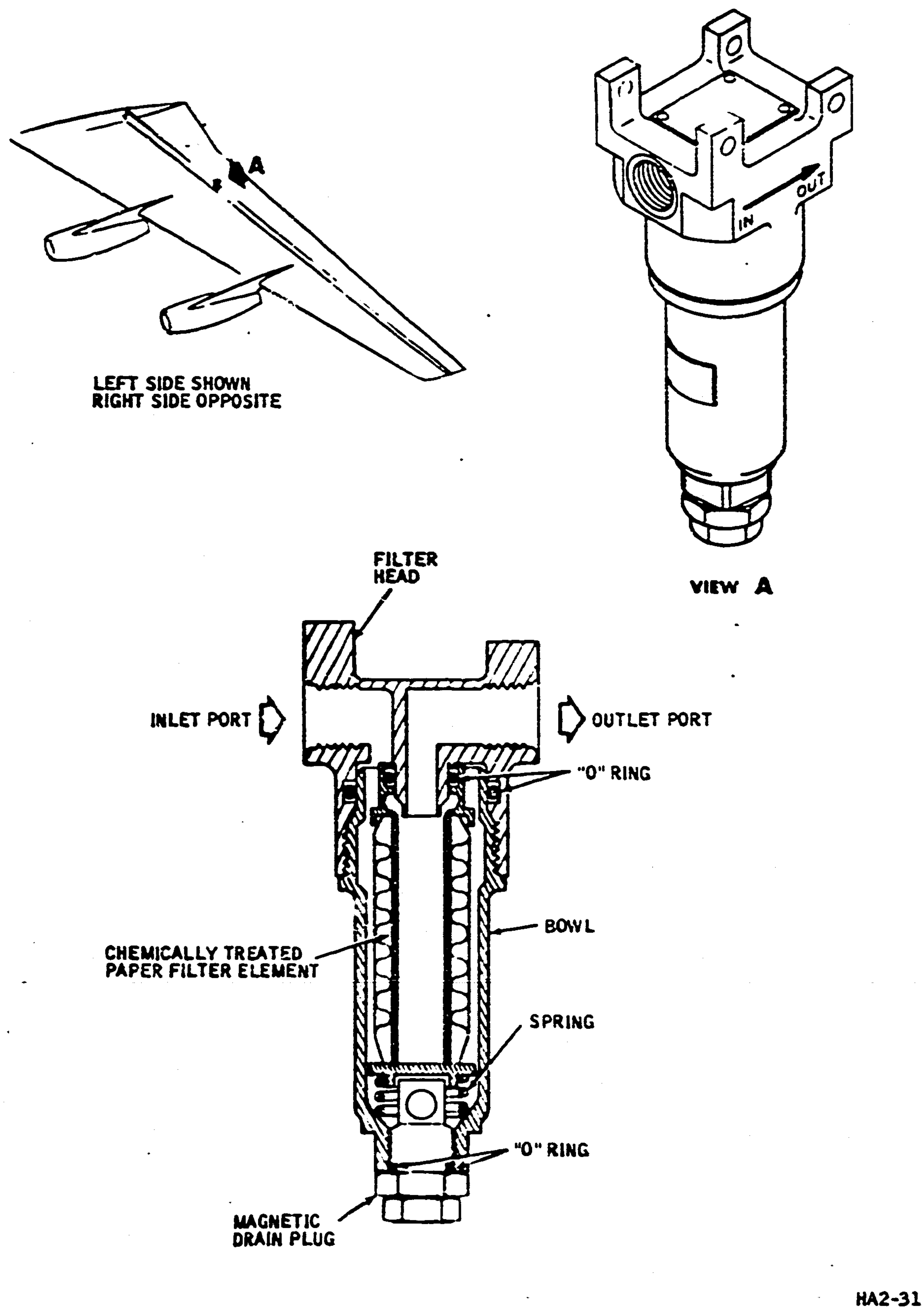
(1) A line-type, micronic filter, for use in a low-pressure hydraulic system, is installed in the engine-driven hydraulic pump case drain line between the pump flow check valve and the hydraulic system reservoir. The case drain filter is installed on the aft surface of the rear spar opposite the leading edge of the inboard flap assembly. One filter is used for each engine-driven pump. Access is gained to the filter by lowering the flaps. A second check valve is installed adjacent to the filter in the downstream side of the case drain return line.

(2) Externally, the filter is approximately 5 inches high and 2 inches wide, with ports marked inlet and outlet. The bowl is cylindrical in shape, with hex-shaped wrench flats at the lower end. A self-sealing, magnetic drain plug is installed in the bottom end of the filter bowl. The filter element is made of chemically treated paper.

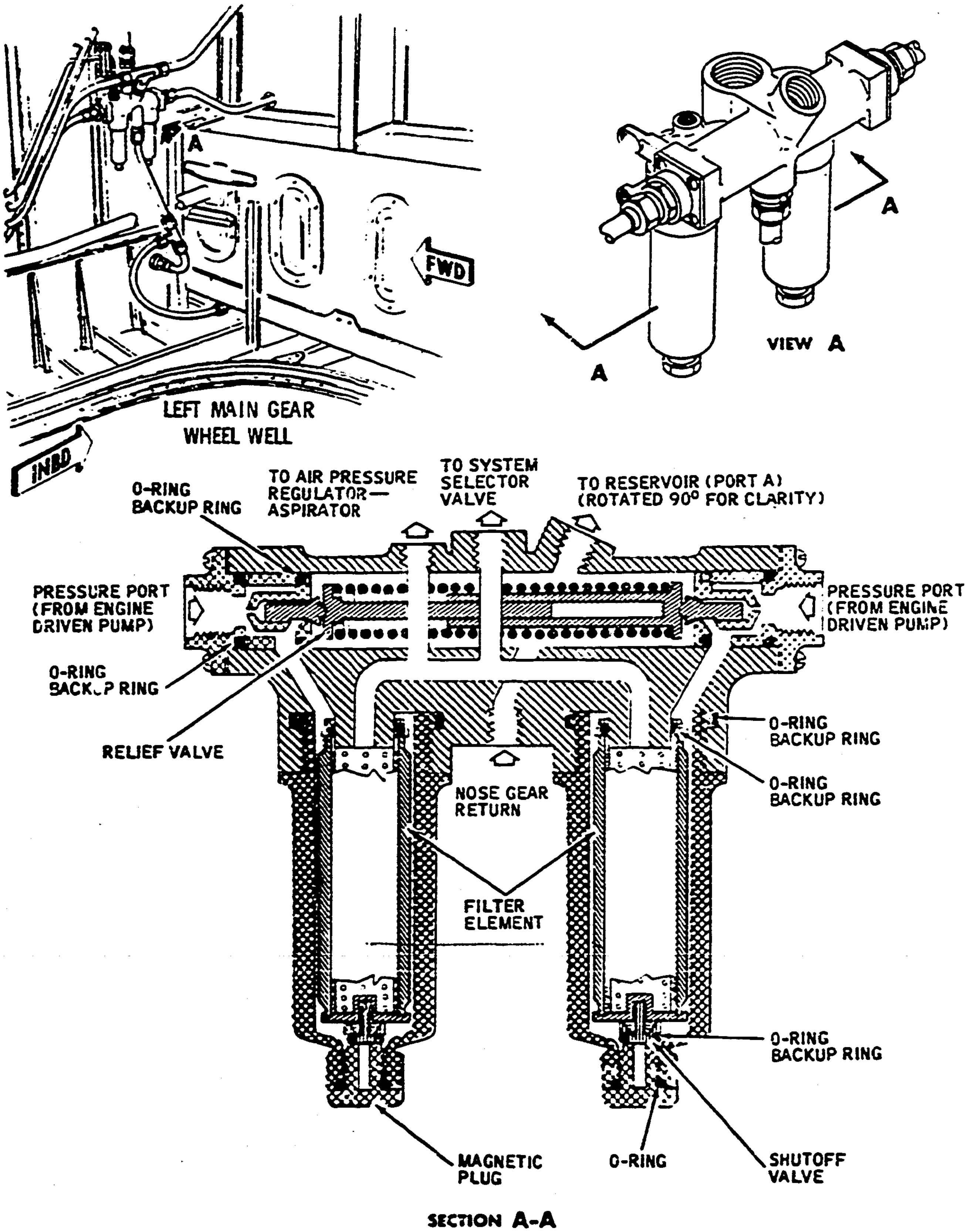
N. Dual Filter and Relief Valve (See Figure 15.)

(1) The hydraulic power system dual filter and relief valve consists of two filters and two relief valves installed in the same body. The unit filters the hydraulic fluid from the two engine-driven hydraulic pumps, and the pressure relief valves assure that excessive pressures do not build up in the pressure line from the pumps. The unit is located in the left main gear wheel well on the lower portion of the rear spar, approximately 1 foot outboard of the centerline shear web.

(2) The unit consists of a casting with a flange-mounted pressure inlet port on each end. Two pressure outlets are located on the top of the casting. One outlet, centrally located, is the main pressure outlet to the system selector valve. The other, located to the left of the selector valve port, is the pressure outlet to the air pressure regulator-aspirator. The return outlet port for the relief valve portion of the unit is located on the center of the aft face of the body, canted upward. The nose gear return line is connected to a check valve installed in a return line port, located between the two filter bowls.



Engine Driven Hydraulic Pump Case Drain
Filter -- Cutaway View
Figure 14



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Dual-Filter and Relief Valve -- Cutaway View
Figure 15

(3) The pressure relief valves are located behind the pressure inlet ports and are connected to the return outlet port of the unit. The inlet from the nose gear return line is routed through the casting to the return outlet port.

(4) If either of the filter elements becomes clogged, pressure above 3000 psi at the inlet port will unseat the poppet. Pressure above 3500 psi will allow full flow of 22.5 gpm to flow to the return port of the unit and back to the reservoir. The relief valves will reseat at approximately 3000 psi.

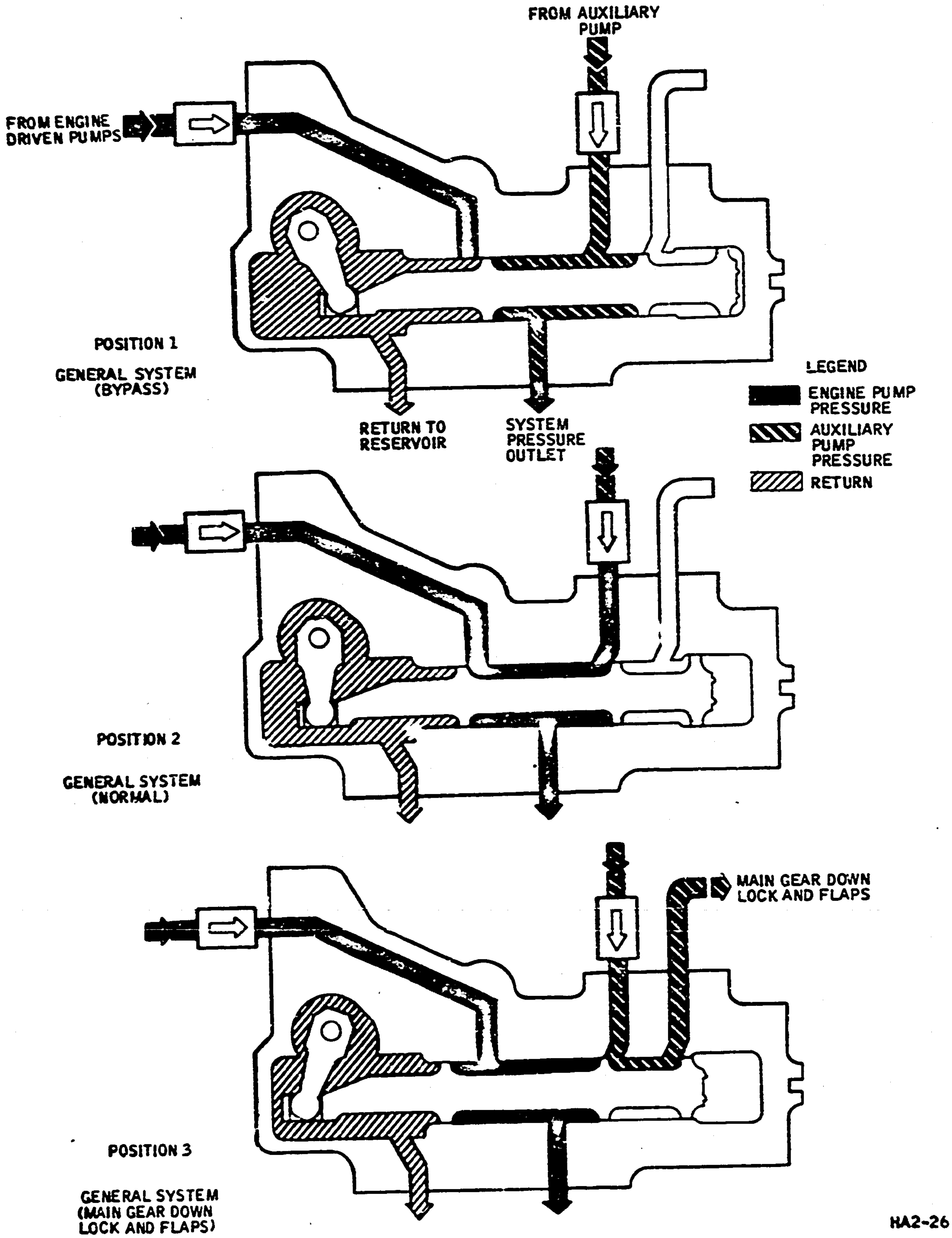
(5) A check valve is installed in the system selector valve port to prevent reverse flow or pressure through the filter during auxiliary hydraulic pump operation.

O. System Selector Valve (See Figures 16 and 17.)

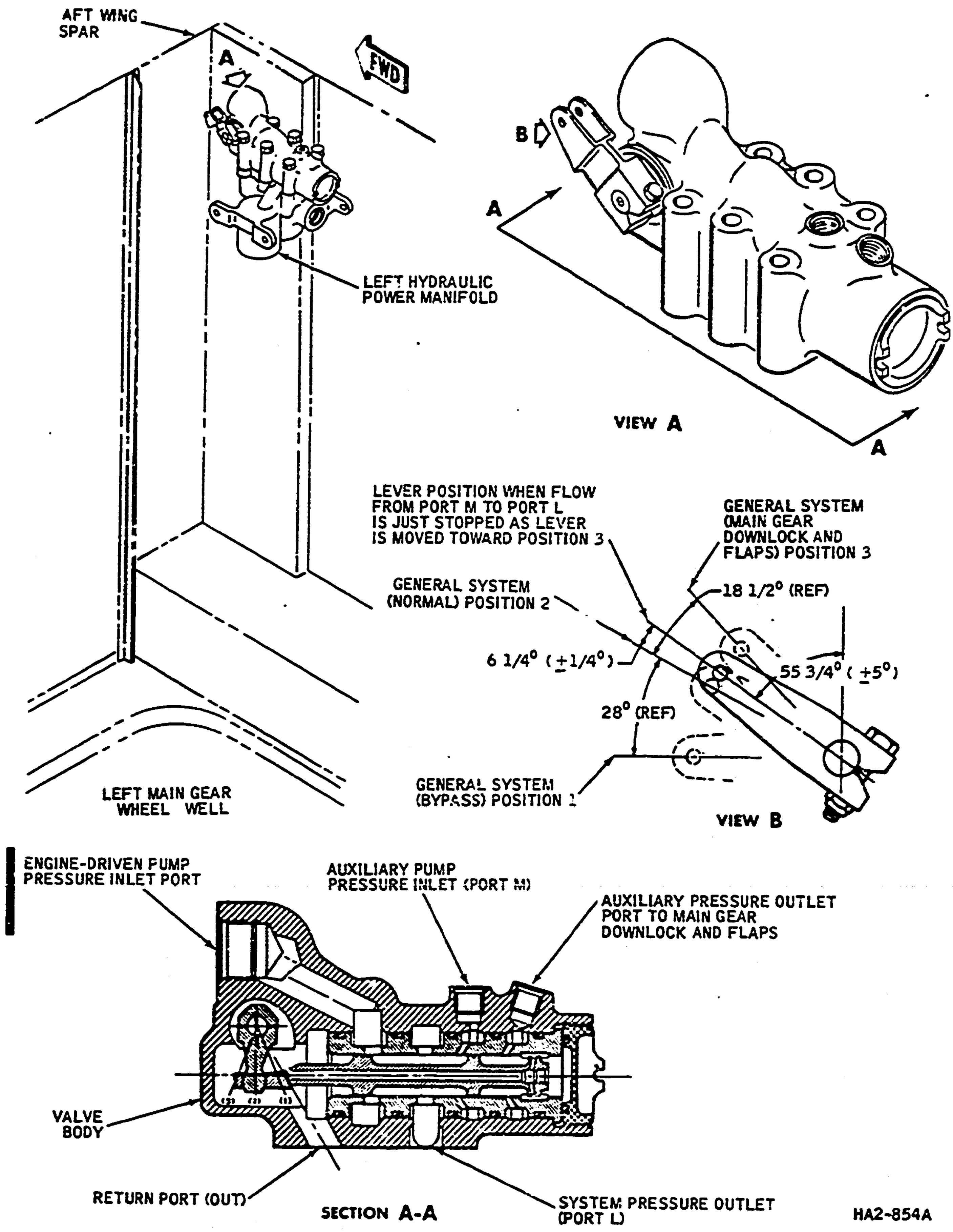
(1) The system selector valve is a 3-position valve which permits directional control of fluid under pressure. The valve is installed on the left hydraulic power manifold and is accessible through the left main gear inboard door.

(2) The selector valve pressure-to-system port and the return port are directly ported to the manifold. The engine pump pressure enters the valve through a port on the large end of the valve, and the auxiliary pump inlet and alternate ports are located at the top, toward the aft end of the valve. The valve control crank is attached to a push-pull rod and a cable sector.

(3) Operation of the system selector valve is controlled by a lever located on the right side of the system engineer's control pedestal. When the control lever is moved to the selected position, the cable system, through the sector and crank, operates the valve positioning lever to drive the slide spool assembly to the selected position. When the control lever is placed in the general system (normal) position; the selector valve is actuated, causing hydraulic fluid to enter the valve through the system pressure port. The fluid is then directed into the manifold through the pressure-to-system port. In the general system (normal) position, fluid from the auxiliary pressure port is also routed to the pressure-to-system port. In the bypass/general system position, the selector valve ports engine pump pressure into the manifold through the return port. In this position, the auxiliary pump pressure is ported to the general system. In the general system/main gear downlock and flaps position, pump pressure is routed through the alternate port, at the top of the valve, for alternate operation of the flaps. Internal leakage provides lubrication for the moving parts of the valve.



System Selector Valve -- Schematic
Figure 16



System Selector Valve -- Cutaway View
Figure 17

P. Left Hydraulic Power Manifold (See Figure 18.)

(1) The left hydraulic power manifold distributes fluid pressure from the hydraulic pump (any one of the three pumps), through control valves to the various airplane hydraulic subsystems. The left power manifold is located overhead in the left wheel well. Access to the left manifold is through the left main gear inboard door.

(2) One valve-mounting pad is provided on the top of the manifold for the system selector valve. Four ports are provided on the manifold for connection of hydraulic pressure and return lines. Three of these ports are pressure outlet ports; one, located on the aft face of the manifold and one located on the bottom of the manifold port fluid to the flight controls. The third pressure outlet port, located on the bottom of the manifold, ports fluid directly to the priority valve, which in turn, ports fluid to the nose gear and to the right power manifold. The fourth, a return port, located immediately forward of the pressure line port on the bottom of the manifold, is connected by a line to a return port of the reservoir.

Q. Right Hydraulic Power Manifold (See Figure 19.)

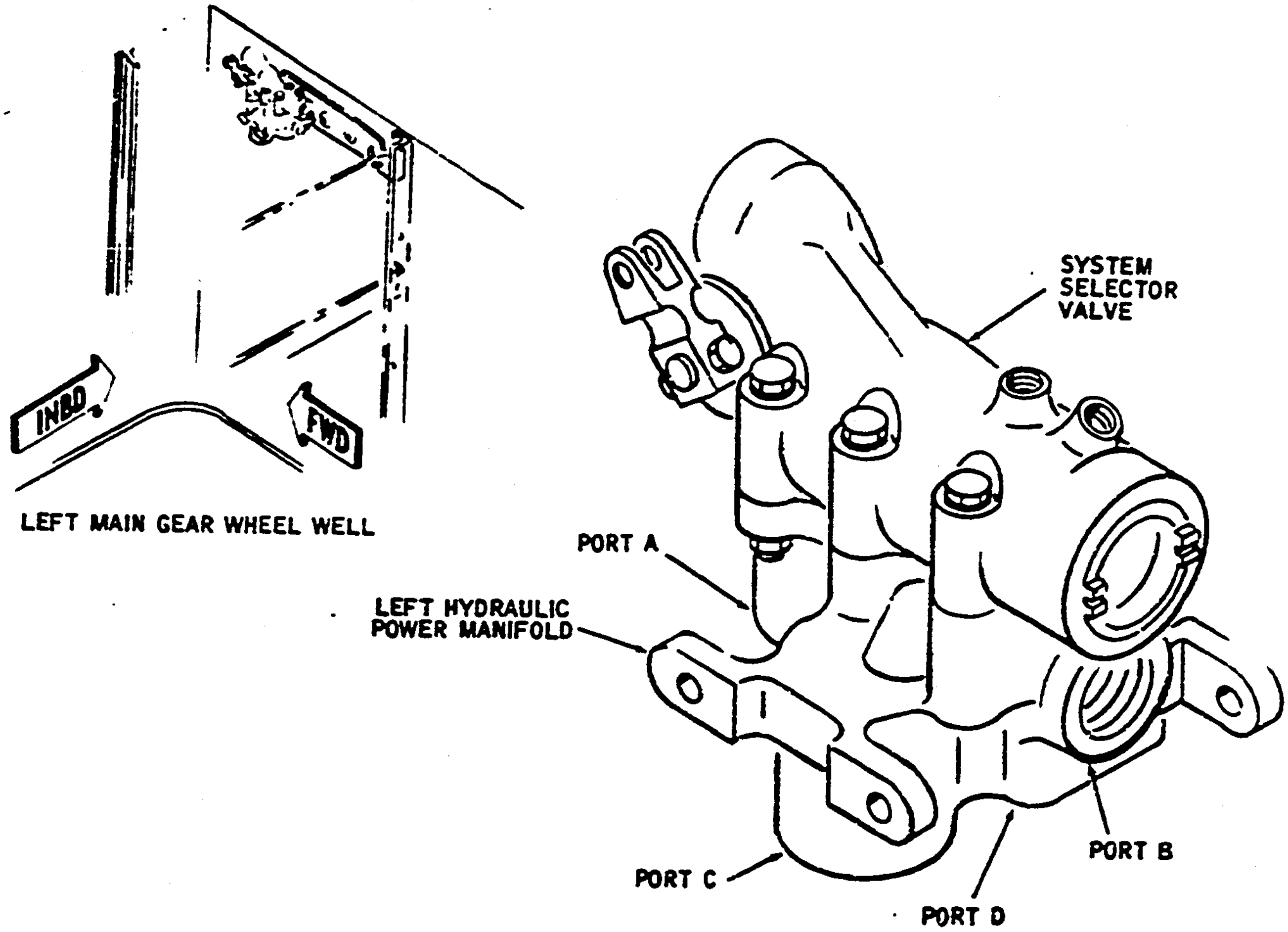
(1) The right hydraulic power manifold distributes fluid pressure from the hydraulic pumps (engine-driven or auxiliary, or any combination of these three pumps), through the control valves to the various hydraulic subsystems. The right hydraulic power manifold is located overhead in the right wheel well. The manifold is held in place with braces and is accessible through the right main gear inboard door.

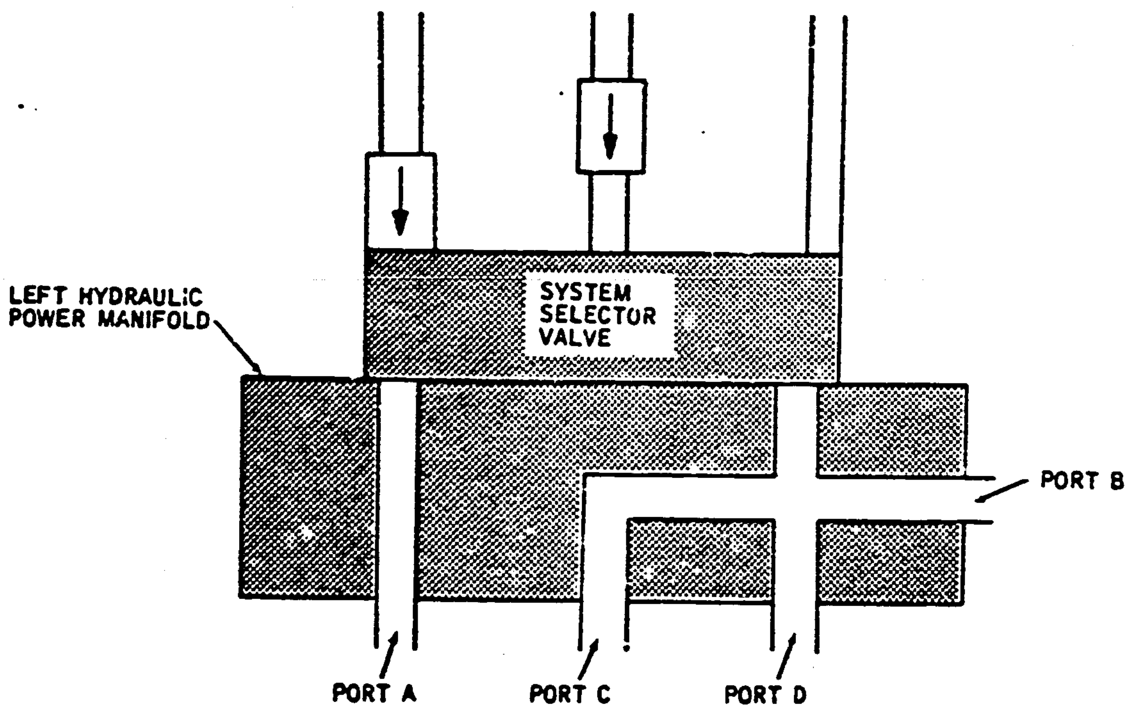
(2) The manifold contains passages for pressure and return fluid distribution, four check valves, ports for pressure and return lines, and mounting pads for the various control valves.

(3) The right manifold receives fluid pressure from the left manifold. Pressure is ported through check valves to the wing flap control valve, to the slot control valve, to the main gear control valve, to the brake control valve, to the brake pressure transmitter, and to the brake accumulators.

(4) Auxiliary hydraulic pressure is ported from the alternate port of the system selector control valve into port K in the right manifold. Port K is located inboard of the spoiler control valve. From port K, auxiliary hydraulic pressure is ported through a check valve to the downstream side of the wing flap control valve check valve and into the wing flap control valve for alternate operation of the wing flaps.

(5) The return passage from the wing flap control valve ports fluid to return port A. The brake control valve return passage ports fluid into return line B through a two-way restrictor. The main gear control valve downline return fluid uses a separate port in the valve, bypasses the





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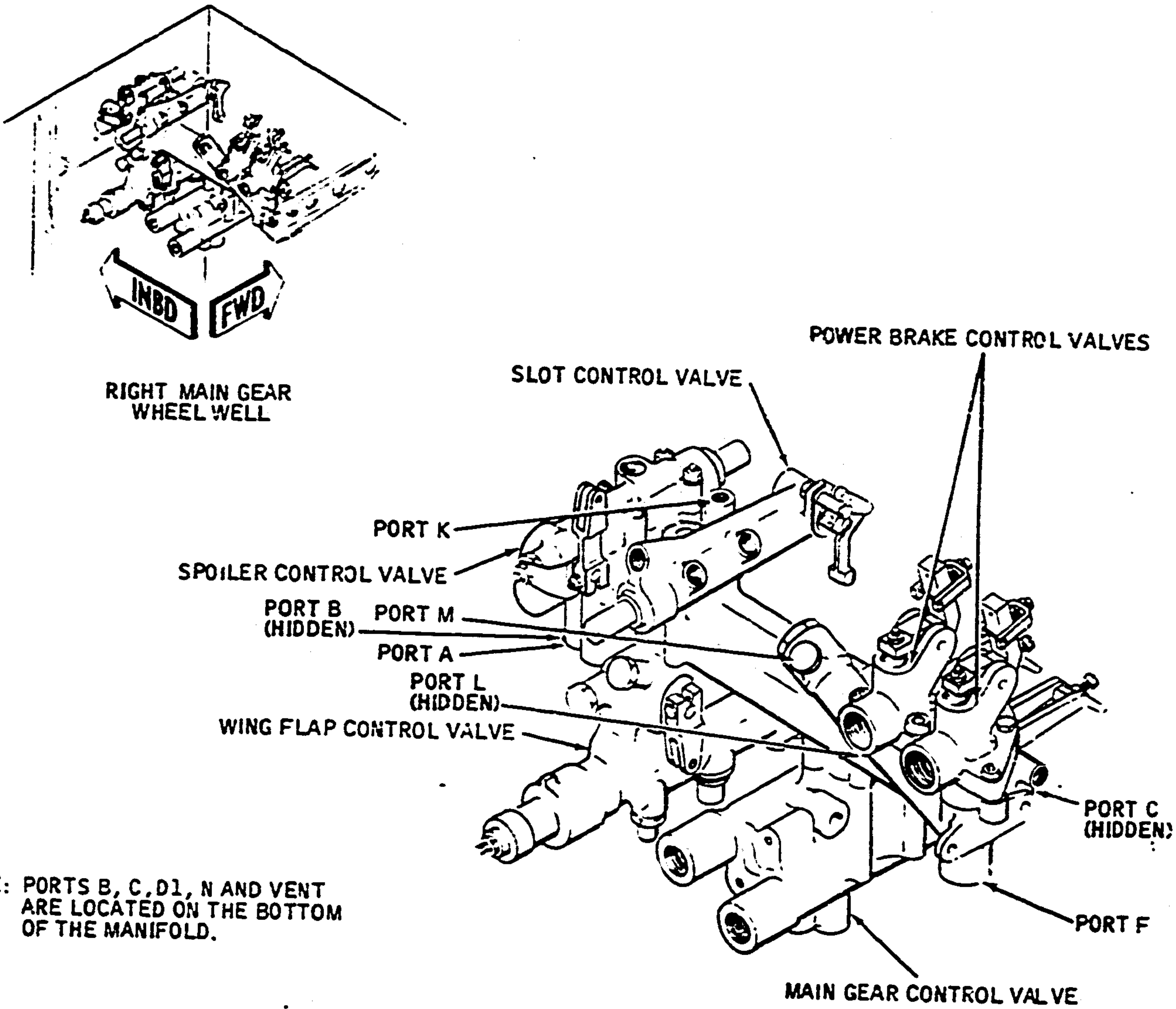
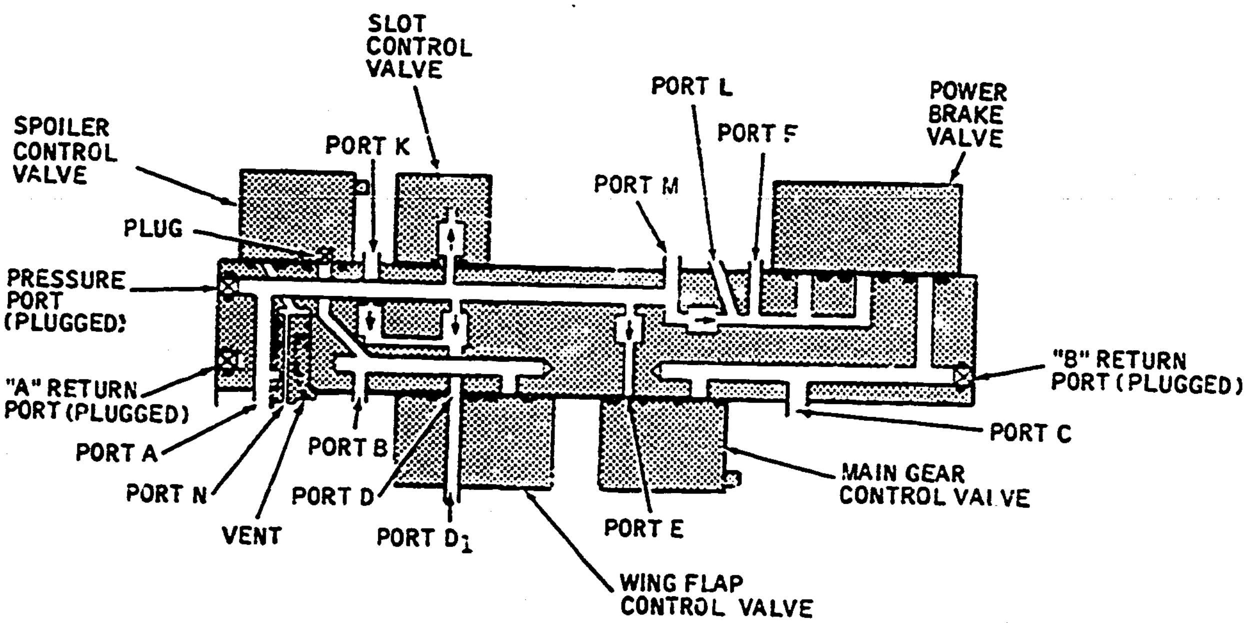
Left Hydraulic Power Manifold -- Schematic
Figure 18



NOTE: PORTS B, C, D1, N AND VENT ARE LOCATED ON THE BOTTOM OF THE MANIFOLD.



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Right Hydraulic Power Manifold -- Schematic
Figure 19

manifold, and returns the fluid directly to A return line to the reservoir. The upline in the main gear control valve uses the same return port, return port B, in the manifold as the brake control valve.

R. Deleted.

S. Hydraulic Power System Accumulator (See Figure 20.)

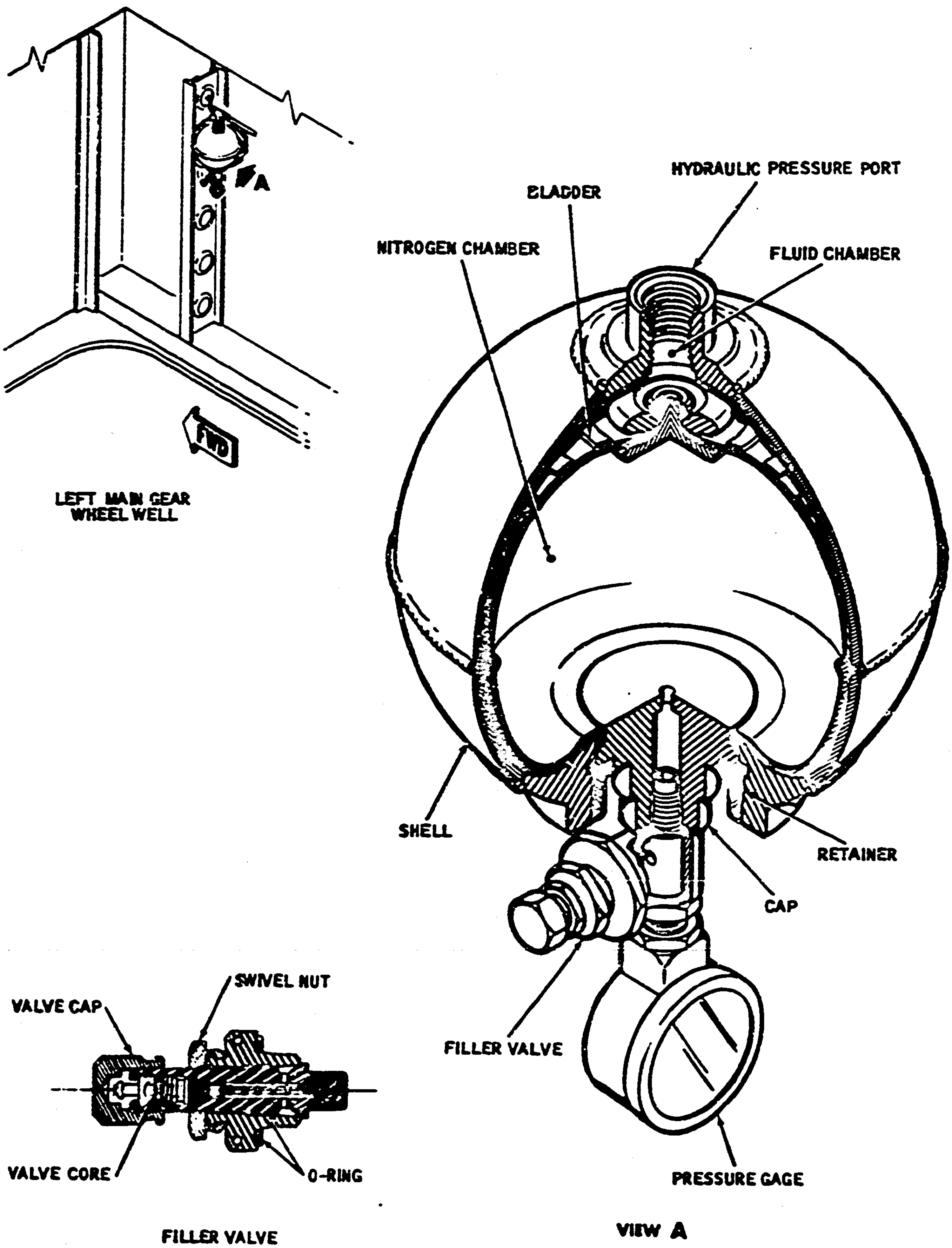
(1) The hydraulic power system accumulator is a spherical, welded-steel, fluid and air bladder-separated container. The accumulator is installed in the pressure line of the hydraulic power system to provide a reserve supply of fluid under pneumatic pressure and to act as a shock absorber for system pressure surges.

(2) The accumulator is located immediately aft of the left hydraulic power manifold and is accessible through the left main gear inboard door. It is mounted with two corner brackets and clamp blocks at the upper and lower port fittings.

(3) The accumulator is installed in the pressure line of the hydraulic power system and is initially charged with 1000 psi of dry nitrogen. As the system pressure builds up, fluid is forced into the upper chamber of the accumulator, further compressing the trapped nitrogen to approximately 3000 psi. With full hydraulic system pressure, 3000 psi is indicated on the pressure gage adjacent to the filler valve. This reserve pressure smooths out any momentary lag in the pump's response to the system's demand for greater fluid flows. The accumulator permits a gradual rise in system pressure, thereby absorbing the shock of pump surges and relieving the piping and system operating units of high-impact loads. When the engine-driven hydraulic pumps are not operating, the accumulator provides system pressure (at a diminishing rate) until a quantity equal to the stored volume in the accumulator has been used by the system.

T. Hydraulic System Priority Valve (See Figure 21.)

(1) The priority valve is located in the left wheel well near the left hydraulic power manifold. The valve is installed in the hydraulic pressure line, between the two power manifolds, downstream of the pressure supply takeoff port for the flight controls. The priority valve is a



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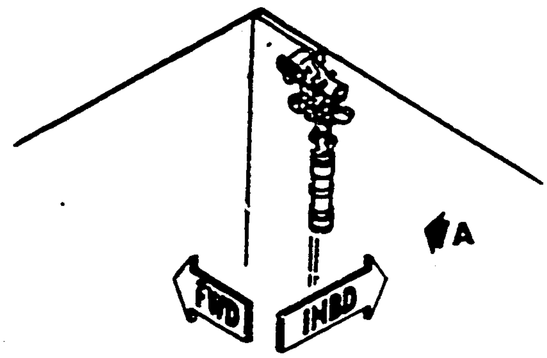
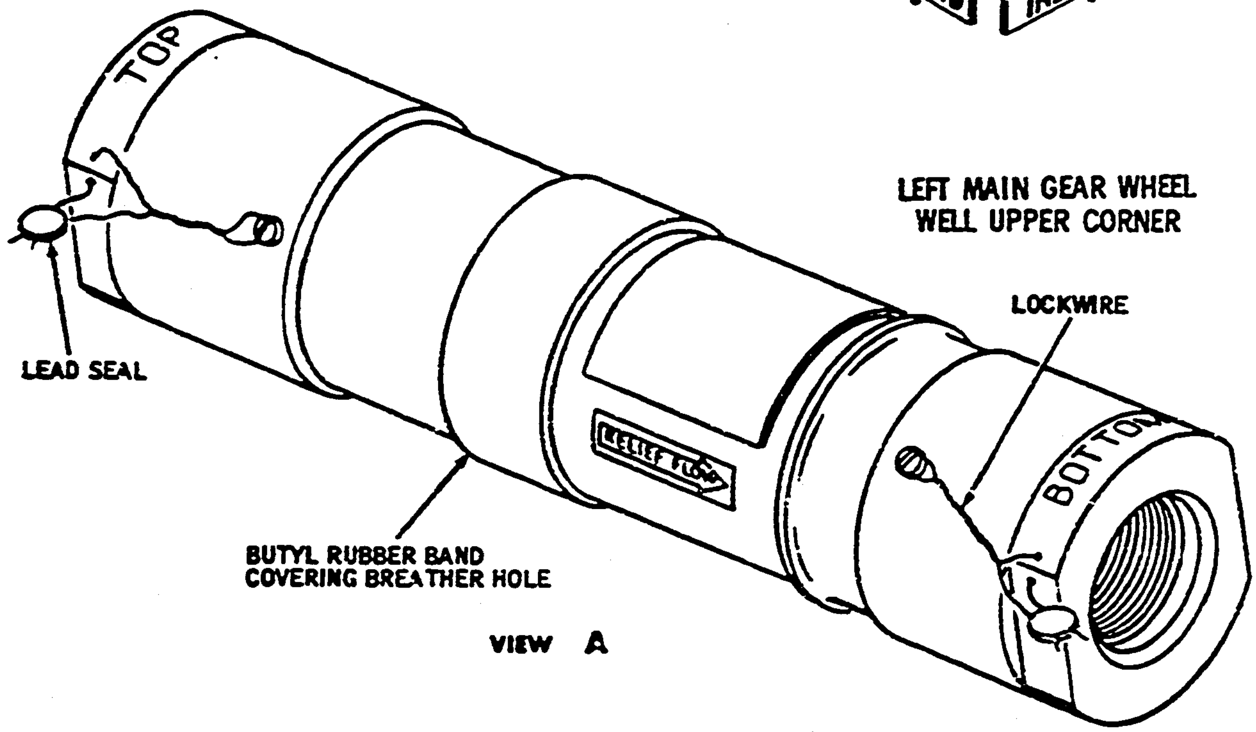
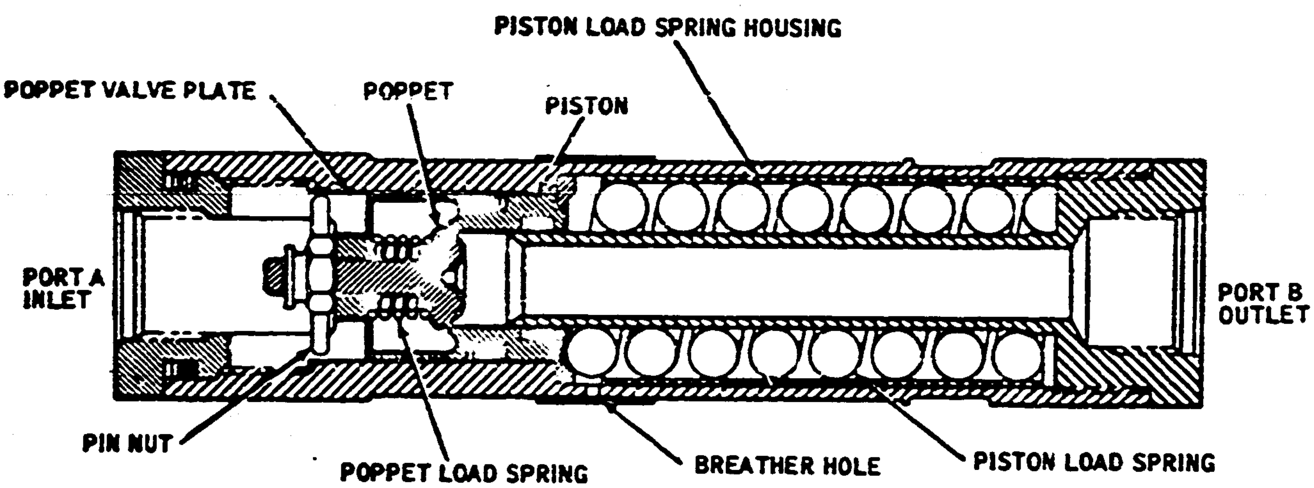
Hydraulic Power System Accumulator --
Cutaway View
Figure 20







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Hydraulic System Priority Valve -- Cutaway View
Figure 21

balanced relief valve which reserves initial hydraulic pressure (up to 2150 psi maximum) for use in the flight control systems. The valve consists of a body with an inlet, an outlet, and a breather port. Internally, the valve contains a poppet valve plate, a poppet, a poppet valve load-spring, a piston, a piston load-spring, and a piston load-spring housing. The piston load-spring housing chamber is vented to ambient air through a breather hole which is covered by a butyl rubber band.

(2) The priority valve shuts off hydraulic pressure to all subsystems downstream of the left power manifold, whenever the hydraulic pressure drops below 1700 psi minimum. At this point, the valve closes to reserve the hydraulic pressure for use in the flight control systems, preventing them from reverting to manual operation. When the hydraulic pressure rises to 2150 maximum, the priority valve opens and supplies pressure to the right manifold and all subsystems downstream of the priority valve.

(3) Hydraulic fluid from the left power manifold enters the priority valve through the inlet port, passes through the poppet valve plate holes, and applies pressure against the piston. When sufficient hydraulic pressure is applied to the piston, the piston load-spring compresses, unseating the poppet and permitting full flow through the valve. When the hydraulic pressure decreases to less than the opposing force value of the piston load-spring, the load-spring forces the piston against the poppet and shuts off fluid flow through the valve.

(4) The maximum flow available from both engine-driven hydraulic pumps is: 44 to 45 gpm at takeoff, climb, and cruise configurations; 26 to 28 gpm at descent, approach, and engine idle configurations.

(5) Some of the larger hydraulic system demands are as follows:

(a) Gear retraction -- 17 gpm (10 - 12 seconds)

(b) Gear extension -- 14 gpm (10 - 12 seconds)

(c) Wing flaps down -- 8 gpm (10 seconds)

(d) Wing flaps up -- 3 gpm (22 seconds)

(e) Horizontal stabilizer -- 7 gpm

(f) Ailerons -- 17 gpm (25°/second)

(g) Rudder -- 3 gpm (25°/second)

(6) There are various combinations of hydraulic system operations which could cause momentary reversion of the flight controls to manual operation, the priority valve assures that the left power manifold receives all the hydraulic fluid pressure under conditions of very large flow demands.

U. Hydraulic System Selector Control Lever

(1) The hydraulic system selector control lever is a manually actuated, mechanical lever detented to three positions. The lever provides a mechanical means, through cables, for positioning the system selector valve and the auxiliary hydraulic pump supply selector valve. The hydraulic system selector control lever is located on the system engineer's control pedestal. The lever is attached to a drive sector, located on a common shaft with the other control pedestal sectors. The lever and sector are accessible through the cover plates on the system engineer's pedestal.

(2) To put the hydraulic power system in the bypass condition, the system selector control lever is lifted out of detent and moved to bypass/general system position. At the same time, the cable moves the sector and pushrod of the system selector valve to the No. 1 position. The pushrod positions the system selector valve to the No. 1 bypass position. At the same time, the cables from the system selector valve sector move the auxiliary pump supply selector valve sector to No. 1 (auxiliary) position. The auxiliary pump supply selector valve remains in the auxiliary supply position through the idle feature of the sector rigging. In this condition, the engine-driven pump pressure is ported to the reservoir and the auxiliary pump supplies pressure to the general system. In this position, the fluid is supplied to the auxiliary pump from the low standpipe in the hydraulic system reservoir. To put the system into the alternate condition, the selector control lever is lifted out of detent and moved to the general system/main gear downlock and flaps position. The cables move the system selector valve sector to the No. 3 (alternate) position. The system selector valve sector moves the cables rotating the auxiliary pump supply selector valve sector to the No. 3 (alternate) position. As the sector rotates, the end of the arm moves away from the idle position. This positions the valves to the alternate position, supplying fluid to the auxiliary pump from the auxiliary pump alternate reservoir. In this position, fluid from the auxiliary pump is ported to the wing flap control valve and main gear downlock cylinders. Engine-driven pump pressure is ported to the general system.

MAIN - TROUBLESHOOTING

1. Troubleshooting

Possible Causes	Isolation Procedure	Correction
A. NO ENGINE-DRIVEN PUMP HYDRAULIC SYSTEM PRESSURE		
(1) Hydraulic system selector control lever in bypass/general system position.	Check control lever for selection.	Place control lever in system (normal position).
(2) Hydraulic pump switches in bypass position.	Check position of switches.	Place switches in on position.
(3) Hydraulic reservoir fluid too low.	Check fluid level or reservoir.	Fill reservoir to proper level.
(4) Dual-filter and relief valve bypassing or filters clogged.	Check function of valve or condition of filters.	Replace relief valve or filters.
(5) Failure of system selector valve.	Check function of valve.	Replace valve.
(6) System selector control valve blocking pressure to system.	Check rigging of valve linkage.	Rig system selector mechanical control system.
	Check for broken or loose cable in control system.	Replace cable if broken, and rig system.
	Check linkage from cable drum to valve operating crank.	Rig system and adjust crank.

Possible Causes	Isolation Procedure	Correction
A. NO ENGINE-DRIVEN PUMP HYDRAULIC SYSTEM PRESSURE (Continued)		
(7) Defective engine-driven hydraulic pump.	Check pump for proper function.	Replace pump.
(8) Fire shutoff valve closed.	Check valve for proper position, function, and rigging.	Repair, replace, or rig valve as necessary.
B. LOW ENGINE-DRIVEN PUMP HYDRAULIC SYSTEM PRESSURE		
(1) Malfunction or dual-filter and relief valve.	Check function of valve.	Replace valve.
(2) Hydraulic leaks in system.	Check for broken lines or loose fittings.	Replace lines or tighten fittings.
(3) Defective hydraulic engine-driven pump.	Check pump for proper function.	Replace pump.
C. FAILURE OF MECHANICAL CONTROL SYSTEM		
(1) Misalignment of system selector control lever and system selector valve.	Check alignment of lever and valve.	Adjust control system to correct alignment.
(2) Too much slack in system cable run.	Check rigging load of cables.	Adjust rigging.

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Possible Causes	Isolation Procedure	Correction
C. FAILURE OF MECHANICAL CONTROL SYSTEM (Continued)		
(3) Broken system selector valve pushrod.	Check condition of pushrod.	Replace pushrod.
D. SLUGGISH ACTION OF MECHANICAL CONTROL SYSTEM		
(1) Frayed cable runs.	Check cables for fraying.	Replace frayed cables.
(2) Binding or cables or pulleys.	Check for obstructions on cables or pulleys	Remove obstructions.
(3) Damaged pulleys.	Check pulleys.	Replace pulleys.

MAIN - ADJUSTMENT/TEST

1. General

A. The hydraulic system selector valve and the auxiliary pump supply selector valve are mechanically connected with a cable system and pushrods. Both valves are simultaneously controlled by the hydraulic system selector control lever in the flight compartment. The following procedures provide adjustment instructions for the system selector valve and auxiliary pump supply selector valve control systems.

B. Turnbuckles on the system selector valve control cables are located in the forward cargo compartment ceiling.

C. Turnbuckles on the auxiliary hydraulic pump supply selector valve control cables are located in the left main gear wheel well.

D. The numbers in parentheses in the following text correspond to callouts in Figure 501.

2. Adjustment/Test Hydraulic Power Mechanical Control System

A. Adjust Control System

(1) Remove hydraulic system selector valve pushrod (4) and auxiliary pump supply selector valve pushrod (8).

(2) Place hydraulic system selector control lever (1) in bypass/general system detent position.

(3) Adjust turnbuckles (2 and 12) on system selector valve control cables to obtain standard rig for 1/16-inch cables (see Figure 502).

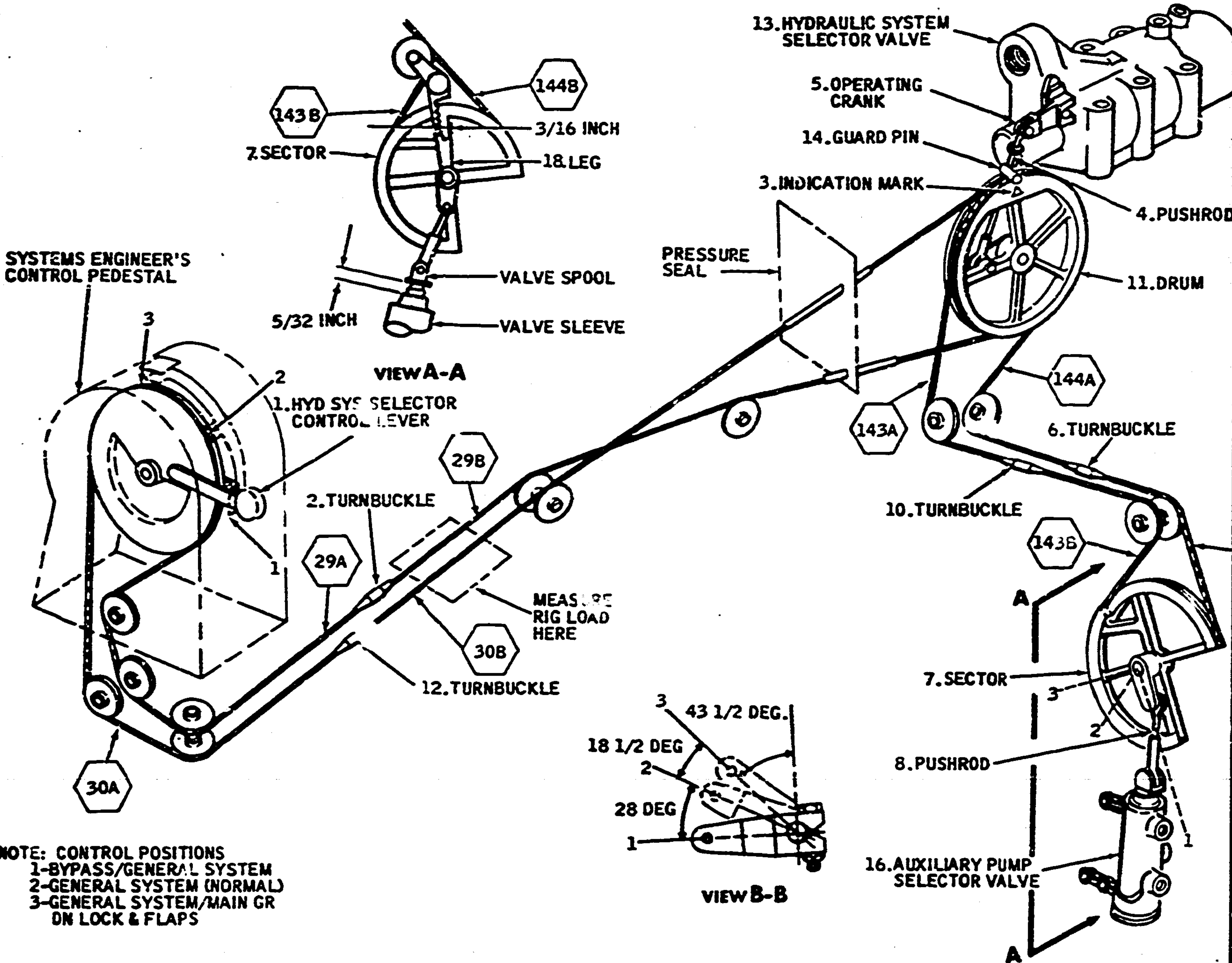
(4) Differentially adjust turnbuckles (2 and 12) on system selector valve control cables, to align indicating mark (3) on drum (11) with upper guard pin (14) in bracket assembly.

(5) Safety turnbuckles (2 and 12) with lockwire.

(6) Place hydraulic system selector control lever (1) in general system (normal) position.

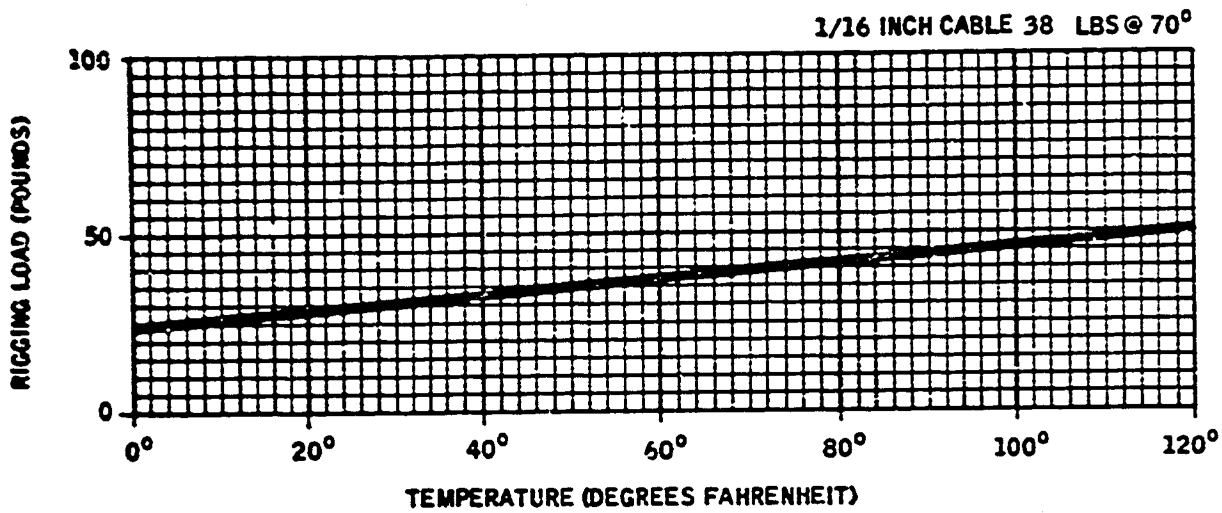
(7) Manually position operating crank (5) of system selector valve (13) so that crank is pointing forward (see Figure 501, view B-B).

HA2-517A



NOTE: CONTROL POSITIONS
1-BYPASS/GENERAL SYSTEM
2-GENERAL SYSTEM (NORMAL)
3-GENERAL SYSTEM/MAIN GR ON LOCK & FLAPS

Hydraulic Power Mechanical Control
System -- Adjustment Diagram
Figure 501



1. GRAPH VALUES INCLUDE 10% STRUCTURAL DEFLECTION.
2. RELIABLE TENSIOMETERS MUST BE USED FOR ADJUSTING THE RIGGING LOADS. THE ACCURACY OF THE RIGGING LOAD MUST BE MAINTAINED WITHIN ±5 POUNDS ON 1/16 INCH CABLE

HA2-199

Cable Rigging Tension Chart
Figure 502

(8) Connect hydraulic test stand to ground service connections, and pressurize hydraulic system (see 29-00).

CAUTION: MAKE CERTAIN THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED AND THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION.

(9) Rotate operating crank (5) up and aft to position where flow through system selector valve stops.

NOTE: Flow stoppage is indicated by a momentary increase in pressure reading of system accumulator pressure gage.

Operating crank (5) is positioned on control valve, during bench check (see Figure 501, view B-B).

(10) Adjust length of system selector valve pushrod (4) to equal measurement between attaching points on drum (11) and operating crank (5) of valve (13).

(11) Lengthen system selector valve pushrod (4) 7/32 inch by rotating each end of pushrod three turns. Secure ends of pushrod, and install on crank (5) and drum (11).

(12) Depressurize hydraulic system (see 29-00).

(13) Place hydraulic system selector control lever in bypass/general system position.

(14) Check alignment of indicating mark on drum (11) with upper guard pin (14) of bracket.

(15) Adjust turnbuckles (6 and 10) on auxiliary pump selector valve (16) control cables to obtain standard rig for 1/16 inch cables (see Figure 502).

(16) Differentially adjust turnbuckles (6 and 10) on auxiliary pump selector valve (16) control cables, to position spoke of auxiliary pump selector valve sector (7) 3/16 inch past edge of leg (18) of its support bracket (see Figure 501, view A-A).

(17) Safety turnbuckles (6 and 10) with lockwire.

(18) Extend spool of auxiliary pump selector valve (16) 5/32 inch beyond valve sleeve (see Figure 501, view A-A).

(19) Adjust length of auxiliary pump selector valve (16) pushrod (8) to match measurement between sector (7) and valve spool. Install pushrod and secure.

B. Test Control System

<u>CAUTION:</u> BEFORE PERFORMING FOLLOWING STEPS, MAKE CERTAIN THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED AND THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION.

(1) Pressurize hydraulic system (see 29-00).

(2) Operate hydraulic system selector control lever several times through full travel.

<u>NOTE:</u> Swaged tubes should extend a minimum of 3/4 inch from the pressure seal at the extremes of cable travel.

(3) Check each lever position in relation to operating crank position (see Figure 501, view B-B).

(4) Place hydraulic system selector control lever in bypass/general system position. Measurement between valve spool and sleeve should be 5/32 inch (see Figure 501, view A-A).

(5) Check that measurement between valve spool and valve sleeve, as pushrod passes over top dead center, is 1/16 inch.

(6) Place hydraulic system selector control lever in general system/main gear downlock and flaps position. Measurement between valve spool and valve sleeve should be 13/16 inch.

(7) Depressurize hydraulic system (see 29-00).

C. Cable Assemblies

NOTE: The cable run numbers and the segment letters in the following chart correspond to the callouts in Figure 501.

Function	Cable Run Number	Segment Letter
Hydraulic bypass (normal and bypass)	29/30	A/A B/B
Hydraulic suction (open and closed)	143/144	A/A
Hydraulic suction (open)	143	B
Hydraulic suction (close)	144	B

MAIN - ADJUSTMENT/TEST

1. General

A. The hydraulic system selector valve and the auxiliary pump supply selector valve are mechanically connected with a cable system and pushrods. Both valves are simultaneously controlled by the hydraulic system selector control lever in the flight compartment. The following procedures provide adjustment instructions for the system selector valve and auxiliary pump supply selector valve control systems.

B. Turnbuckles on the system selector valve control cables are located in the forward cargo compartment ceiling.

C. Turnbuckles on the auxiliary hydraulic pump supply selector valve control cables are located in the left main gear wheel well.

D. The numbers in parentheses in the following text correspond to callouts in Figure 501.

2. Adjustment/Test Hydraulic Power Mechanical Control System

A. Adjust Control System

(1) Remove hydraulic system selector valve pushrod (4) and auxiliary pump supply selector valve pushrod (8).

(2) Place hydraulic system selector control lever (1) in bypass/general system detent position.

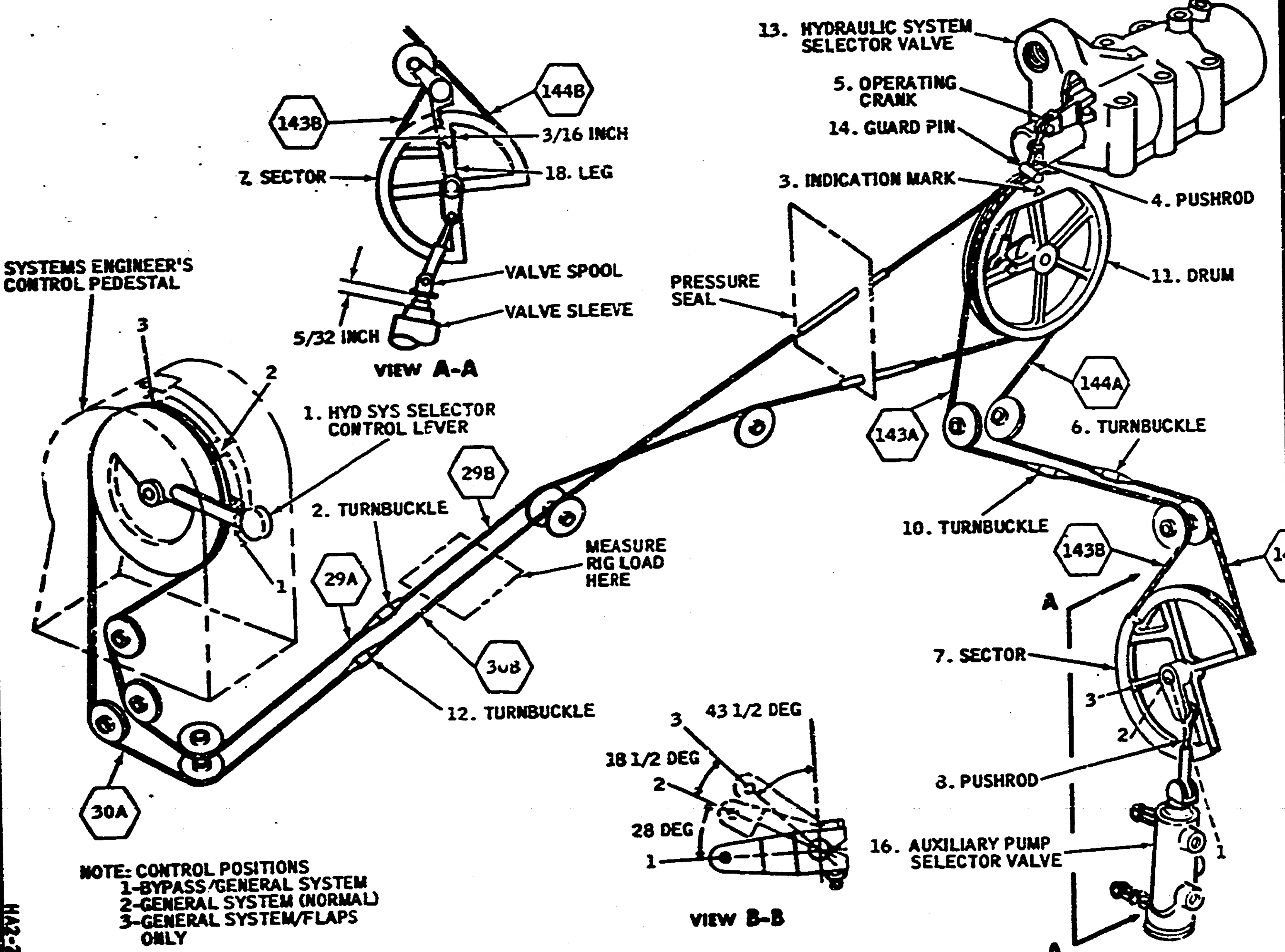
(3) Adjust turnbuckles (2 and 12) on system selector valve control cables to obtain standard rig for 1/16-inch cables (see Figure 502).

(4) Differentially adjust turnbuckles (2 and 12) on system selector valve control cables, to align indicating mark (3) on drum (11) with upper guard pin (14) in bracket assembly.

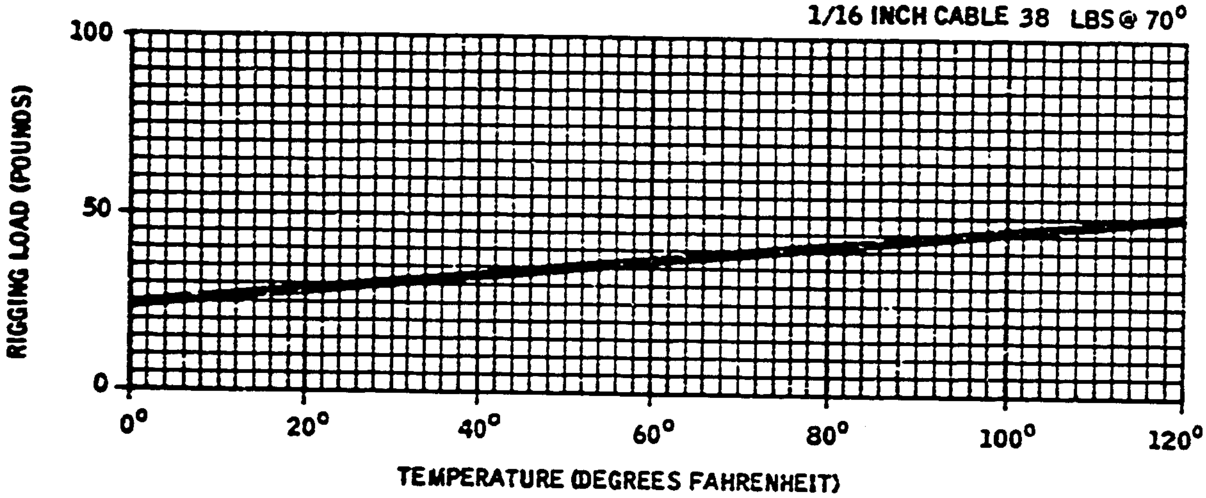
(5) Safety turnbuckles (2 and 12) with lockwire.

(6) Place hydraulic system selector control lever (1) in general system (normal) position.

(7) Manually position operating crank (5) of system selector valve (13) so that crank is pointing forward (see Figure 501, view B-B).



Hydraulic Power Mechanical Control System -- Adjustment Diagram
Figure 501



1. GRAPH VALUES INCLUDE 10% STRUCTURAL DEFLECTION.
2. RELIABLE TENSIOMETERS MUST BE USED FOR ADJUSTING THE RIGGING LOADS. THE ACCURACY OF THE RIGGING LOAD MUST BE MAINTAINED WITHIN ±5 POUNDS ON 1/16 INCH CABLE

HA2-199

Cable Rigging Tension Chart
Figure 502

(8) Connect hydraulic test stand to ground service connections, and pressurize hydraulic system (see 29-00).

CAUTION: MAKE CERTAIN THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED AND THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION.

(9) Rotate operating crank (5) up and aft to position where flow through system selector valve stops.

NOTE: Flow stoppage is indicated by a momentary increase in pressure reading of system accumulator pressure gage.

Operating crank (5) is positioned on control valve, during bench check (see Figure 501, view B-B).

(10) Adjust length of system selector valve pushrod (4) to equal measurement between attaching points on drum (11) and operating crank (5) of valve (13).

(11) Lengthen system selector valve pushrod (4) 7/32 inch by rotating each end of pushrod three turns. Secure ends of pushrod, and install on crank (5) and drum (11).

(12) Depressurize hydraulic system (see 29-00).

(13) Place hydraulic system selector control lever in bypass/general system position.

(14) Check alignment of indicating mark on drum (11) with upper guard pin (14) of bracket.

(15) Adjust turnbuckles (6 and 10) on auxiliary pump selector valve (16) control cables to obtain standard rig for 1/16 inch cables (see Figure 502).

(16) Differentially adjust turnbuckles (6 and 10) on auxiliary pump selector valve (16) control cables, to position spoke of auxiliary pump selector valve sector (7) 3/16 inch past edge of leg (13) of its support bracket (see Figure 501, view A-A).

(17) Safety turnbuckles (6 and 10) with lockwire.

(18) Extend spool of auxiliary pump selector valve (16) 5/32 inch beyond valve sleeve (see Figure 501, view A-A).

(19) Adjust length of auxiliary pump selector valve (16) pushrod (8) to match measurement between sector (7) and valve spool. Install pushrod and secure.

B. Test Control System

<u>CAUTION:</u> BEFORE PERFORMING FOLLOWING STEPS, MAKE CERTAIN THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED AND THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION.

(1) Pressurize hydraulic system (see 29-00).

(2) Operate hydraulic system selector control lever several times through full travel.

<u>NOTE:</u> Swaged tubes should extend a minimum of 3/4 inch from the pressure seal at the extremes of cable travel.

(3) Check each lever position in relation to operating crank position (see Figure 501, view B-B).

(4) Place hydraulic system selector control lever in bypass/general system position. Measurement between valve spool and sleeve should be 5/32 inch (see Figure 501, view A-A).

(5) Check that measurement between valve spool and valve sleeve, as pushrod passes over top dead center, is 1/16 inch.

(6) Place hydraulic system selector control lever in general system/flaps only position. Measurement between valve spool and valve sleeve should be 13/16 inch.

(7) Depressurize hydraulic system (see 29-00).

C. Cable Assemblies

<u>NOTE</u>: The cable run numbers and the segment letters in the following chart correspond to the callouts in Figure 501.

Function	Cable Run Number	Segment Letter
Hydraulic bypass (normal and bypass)	29/30	A/A B/B
Hydraulic suction (open and closed)	143/144	A/A
Hydraulic suction (open)	143	B
Hydraulic suction (close)	144	B

MAIN - INSPECTION/CHECK

1. General

A. When any portion of the hydraulic system has been replaced or repaird, the affected system should be checked for normal operation and for leakage. To check a system for leaks, follow the basic instructions in the applicable paragraph of the leak check procedure using normal pressure of 3000 psi on the system. The operational test procedures for each subsystem will be found in the applicable chapter and section for that system. Examples: Landing gear, Chapter 32; Flight Controls, Chapter 27, etc.

2. Tools and Equipment Required

A. Hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm and 3000 psi using Skydrol hydraulic fluid. The maximum operating temperature should not exceed 180°F (82.2°C).

B. Hydraulic gage capable of indicating 4000 psi maximum for reading brake pressures.

C. Pressure cylinder equipped with pressure regulator (3000 psi, clean, dry compressed nitrogen or air) for checking airbrake system, reservoir pressurization system, and suction system.

D. Bubble fluid solution, MIL-L-25567, for leak checking reservoir air connections.

3. Inspection/Check Main Hydraulic System

A. Leak Check Main Hydraulic System Preliminary Procedures

(1) Open main gear inboard doors (see Chapter 32).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION, AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Make certain that all control valves have been properly adjusted and that all hydraulic lines and air brake lines are properly connected.

(3) Connect hydraulic test stand to airplane ground service pressure and supply connections (see 29-00).

(4) Pressurize hydraulic system to 3000 psi (see 29-00).

WARNING: BEFORE PRESSURIZING HYDRAULIC SYSTEM MAKE CERTAIN THAT POSITION OF FLAP CONTROL LEVER AGREES WITH FLAP POSITION.

B. Leak Check General System and Landing Gear Downlines

(1) Perform leak check preliminary procedures.

(2) Check main gear wheels, release parking brakes, and check parking brake lever linkage for freedom of movement. If linkage is not free, refer to Chapter 32.

(3) Place aileron and rudder hydraulic power shutoff valve control levers in off position.

(4) Hold pressure on system for at least 5 minutes. Check all pressure lines, return lines, and fittings in general system, landing gear downlines, nose gear downlines, brake accumulator lines, nosewheel steering lines, and nosewheel steering reserve accumulator lines for leaks.

(5) Disconnect nosewheel torque links, and place upper torque link in compressed oleo position.

(6) Operate nosewheel steering fully in both directions. Hold pressure in each position for 5 minutes. Check all lines and fittings in nosewheel steering and reserve pressure accumulator system and bogie swivel unlock system for external leaks.

(7) Depressurize hydraulic system.

C. Leak Check Landing Gear Uplines and Fittings

(1) Perform leak check preliminary procedures.

(2) Place landing gear control lever in up position.

WARNING: MAKE CERTAIN THAT LANDING GEAR LOCKPINS ARE PROPERLY INSTALLED.

(3) Close main gear inboard doors; hold pressure for at least 5 minutes, open doors, and check landing gear uplines and fittings for leaks.

(4) Place landing gear control lever in down position.

(5) Depressurize hydraulic system (see 29-00).

D. Leak Check Wing Flap Lines and Fittings

(1) Perform leak check preliminary procedures.

(2) Place wing flap handle in up position.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(3) Hold pressure on system for at least 5 minutes. Place wing flap handle in down position, and hold pressure on system for at least 5 minutes.

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(4) Depressurize hydraulic system.

(5) Check all wing flap lines and fittings for leaks.

E. Leak Check Control Surface Systems Lines and Fittings

(1) Perform leak check preliminary procedures.

(2) Place aileron and rudder hydraulic power shutoff valve control levers in on position, and place wing flap handle in down position.

(3) Move rudder, ailerons, and horizontal stabilizer surfaces to their extreme positions.

(4) Hold pressure on these systems for at least 5 minutes, and then check all lines and fittings in the aileron and rudder systems for leaks.

(5) Move surfaces in the opposite direction.

(6) Hold pressure for at least 5 minutes, and then check all lines and fittings for leaks.

(7) Place aileron and rudder shutoff valves in off position.

(8) Depressurize hydraulic system.

F. Leak Check Brake System Lines and Fittings

(1) Install a 3000 psi gage at one pair of brakes of each main gear.

(2) Perform leak check preliminary procedures.

(3) Depress each brake pedal to give 2000 psi indication on gages installed at brakes.

<u>CAUTION</u>: DO NOT EXCEED 2500 PSI AT THE BRAKES.

(4) Hold pressure for at least 5 minutes, and check all lines and fittings for leaks.

(5) Depressurize hydraulic system.

(6) Remove gages from brakes.

(7) Bleed brakes (see Chapter 32).

G. Leak Check Emergency Airbrake System

(1) Make certain airbrake control lever in flight compartment is on off position.

(2) Pressurize emergency airbrake air bottle to 3000 psi (see Chapter 32); hold pressure, and check lines, fittings, and valves for external leaks. Allow for temperature variations during check (see Chapter 12 for variation chart).

(3) Depressurize airbrake air bottle (see Chapter 32).

(4) Disconnect and plug airbrake lines at shuttle valves, located at lower side of brake lockout cylinders on each main gear strut.

(5) Disconnect brake outlet lines from air brake control valve, and connect lines to compressed air or nitrogen cylinder.

(6) Apply 2500 psi air pressure to airbrake lines; hold pressure, and check lines and fittings for leaks.

(7) Relieve air pressure, and restore system to original configuration. Pressurize airbrake air bottle to 3000 (+100, -0) psi.

H. Leak Check Rudder Standby Hydraulic Power System

(1) Operate rudder standby hydraulic pump to pressurize rudder power system.

(2) Operate rudder to left and right positions; check all lines and fittings for leaks.

(3) Shut down rudder standby hydraulic pump.

I. Leak Check Suction System

(1) Close No. 2 and No. 3 engine's hydraulic fire shutoff valves.

(2) Disconnect drain line from outlet port of reservoir relief valve, located downstream of reservoir air bleed valve at forward end of left main gear wheel well. Cap relief valve outlet port.

(3) Apply 50 psi pressure to suction system through ground service supply connection, using regulated cylinder supply.

(4) Check all supply lines and fittings for leakage.

(5) Bubble check following connections:

(a) Regulator-aspirator outlet port, and inlet port on reservoir.

(b) All eight gage connections and ports.

(c) All bleed valve and relief valve connections.

(6) Remove cap from relief valve. Valve should relieve pressure at 45 (+5 -0) psi.

(7) Connect drain line to outlet port of reservoir relief valve.

(8) Open engine hydraulic fire shutoff valves.

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MAIN - INSPECTION/CHECK

1. General

A. When any portion of the hydraulic system has been replaced or repaired, the affected system should be checked for normal operation and for leakage. To check a system for leaks, follow the basic instructions in the applicable paragraph of the leak check procedure using normal pressure of 3000 psi on the system. The operational test procedures for each subsystem will be found in the applicable chapter and section for that system. Examples: Landing gear, Chapter 32; Flight Controls, Chapter 27, etc.

2. Tools and Equipment Required

A. Hydraulic test stand equipped with a variable-displacement hydraulic pump capable of delivering 20 gpm and 3000 psi using Skydrol hydraulic fluid. The maximum operating temperature should not exceed 180°F (82.2°C).

B. Hydraulic gage capable of indicating 4000 psi maximum for reading brake pressures.

C. Pressure cylinder equipped with pressure regulator (3000 psi, clean, dry compressed nitrogen or air) for checking airbrake system, reservoir pressurization system, and suction system.

D. Bubble fluid solution, MIL-L-25567, for leak checking reservoir air connections.

3. Inspection/Check Main Hydraulic System

A. Leak Check Main Hydraulic System Preliminary Procedures

(1) Open main gear inboard doors (see Chapter 32).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION, AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Make certain that all control valves have been properly adjusted and that all hydraulic lines and air brake lines are properly connected.

(3) Connect hydraulic test stand to airplane ground service pressure and supply connections (see 29-00).

(4) Pressurize hydraulic system to 3000 psi (see 29-00).

WARNING: BEFORE PRESSURIZING HYDRAULIC SYSTEM MAKE CERTAIN THAT POSITION OF FLAP CONTROL LEVER AGREES WITH FLAP POSITION.

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B. Leak Check General System and Landing Gear Downlines

(1) Perform leak check preliminary procedures.

(2) Check main gear wheels, release parking brakes, and check parking brake lever linkage for freedom of movement. If linkage is not free, refer to Chapter 32.

(3) Place aileron and rudder hydraulic power shutoff valve control levers in off position.

(4) Hold pressure on system for at least 5 minutes. Check all pressure lines, return lines, and fittings in general system, landing gear downlines, nose gear downlines, brake accumulator lines, nosewheel steering lines, and nosewheel steering reserve accumulator lines for leaks.

(5) Disconnect nosewheel torque links, and place upper torque link in compressed oleo position.

(6) Operate nosewheel steering fully in both directions. Hold pressure in each position for 5 minutes. Check all lines and fittings in nosewheel steering and reserve pressure accumulator system for external leaks.

(7) Depressurize hydraulic system.

C. Leak Check Landing Gear Uplines and Fittings

(1) Perform leak check preliminary procedures.

(2) Place landing gear control lever in up position.

WARNING: MAKE CERTAIN THAT LANDING GEAR LOCKPINS ARE PROPERLY INSTALLED.

(3) Close main gear inboard doors; hold pressure for at least 5 minutes, open doors, and check landing gear uplines and fittings for leaks.

(4) Place landing gear control lever in down position.

(5) Depressurize hydraulic system (see 29-00).

D. Leak Check Wing Flap Lines and Fittings

(1) Perform leak check preliminary procedures.

(2) Place wing flap handle in up position.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(3) Hold pressure on system for at least 5 minutes. Place wing flap handle in down position, and hold pressure on system for at least 5 minutes.

(4) Depressurize hydraulic system.

(5) Check all wing flap lines and fittings for leaks.

E. Leak Check Control Surface Systems Lines and Fittings

(1) Perform leak check preliminary procedures.

(2) Place aileron and rudder hydraulic power shutoff valve control levers in on position, and place wing flap handle in down position.

(3) Move rudder, ailerons, and horizontal stabilizer surfaces to their extreme positions.

(4) Hold pressure on these systems for at least 5 minutes, and then check all lines and fittings in the aileron and rudder systems for leaks.

(5) Move surfaces in the opposite direction.

(6) Hold pressure for at least 5 minutes, and then check all lines and fittings for leaks.

(7) Place aileron and rudder shutoff valves in off position.

(8) Depressurize hydraulic system.

F. Leak Check Brake System Lines and Fittings

(1) Install a 3000 psi gage at one brake of each main gear.

(2) Perform leak check preliminary procedures.

(3) Depress each brake pedal to give 2000 psi indication on gages installed at brakes.

CAUTION: DO NOT EXCEED 2500 PSI AT THE BRAKES.

(4) Hold pressure for at least 5 minutes, and check all lines and fittings for leaks.

(5) Depressurize hydraulic system.

(6) Remove gages from brakes.

(7) Bleed brakes (see Chapter 32).

G. Leak Check Emergency Airbrake System

(1) Make certain airbrake control lever in flight compartment is on off position.

(2) Pressurize emergency airbrake air bottle to 3000 psi (see Chapter 32); hold pressure, and check lines, fittings, and valves for external leaks. Allow for temperature variations during check (see Chapter 12 for variation chart).

(3) Depressurize airbrake air bottle (see Chapter 32).

(4) Disconnect and plug airbrake lines at shuttle valves, located at lower side of brake lockout cylinders on each main gear strut.

(5) Disconnect brake outlet lines from air brake control valve, and connect lines to compressed air or nitrogen cylinder.

(6) Apply 2500 psi air pressure to airbrake lines; hold pressure, and check lines and fittings for leaks.

(7) Relieve air pressure, and restore system to original configuration. Pressurize airbrake air bottle to 3000 (+100, -0) psi.

H. Leak Check Rudder Standby Hydraulic Power System

(1) Operate rudder standby hydraulic pump to pressurize rudder power system.

(2) Operate rudder to left and right positions; check all lines and fittings for leaks.

(3) Shut down rudder standby hydraulic pump.

I. Leak Check Suction System

(1) Close No. 2 and No. 3 engine's hydraulic fire shutoff valves.

(2) Disconnect drain line from outlet port of reservoir relief valve, located downstream of reservoir air bleed valve at forward end of left main gear wheel well. Cap relief valve outlet port.

(3) Apply 50 psi pressure to suction system through ground service supply connection, using regulated cylinder supply.

(4) Check all supply lines and fittings for leakage.

(5) Bubble check following connections:

(a) Regulator-aspirator outlet and inlet portion on reservoir.

(b) All eight gage connections and ports.

(c) All bleed valve and relief valve connections.

(6) Remove cap from relief valve. Valve should relieve pressure at 45 (+5 -0) psi.

(7) Connect drain line to outlet port of reservoir relief valve.

(8) Open engine hydraulic fire shutoff valves.

HYDRAULIC SYSTEM RESERVOIR - MAINTENANCE PRACTICES

1. General

   A. The hydraulic system reservoir is located on the aft side of the rear spar in the left wing root.

   B. Access is through the left wing root access door.

2. Removal/Installation Hydraulic System Reservoir

   A. Remove Reservoir

      (1) Open following circuit breakers:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect line from low standpipe port at bottom of reservoir.

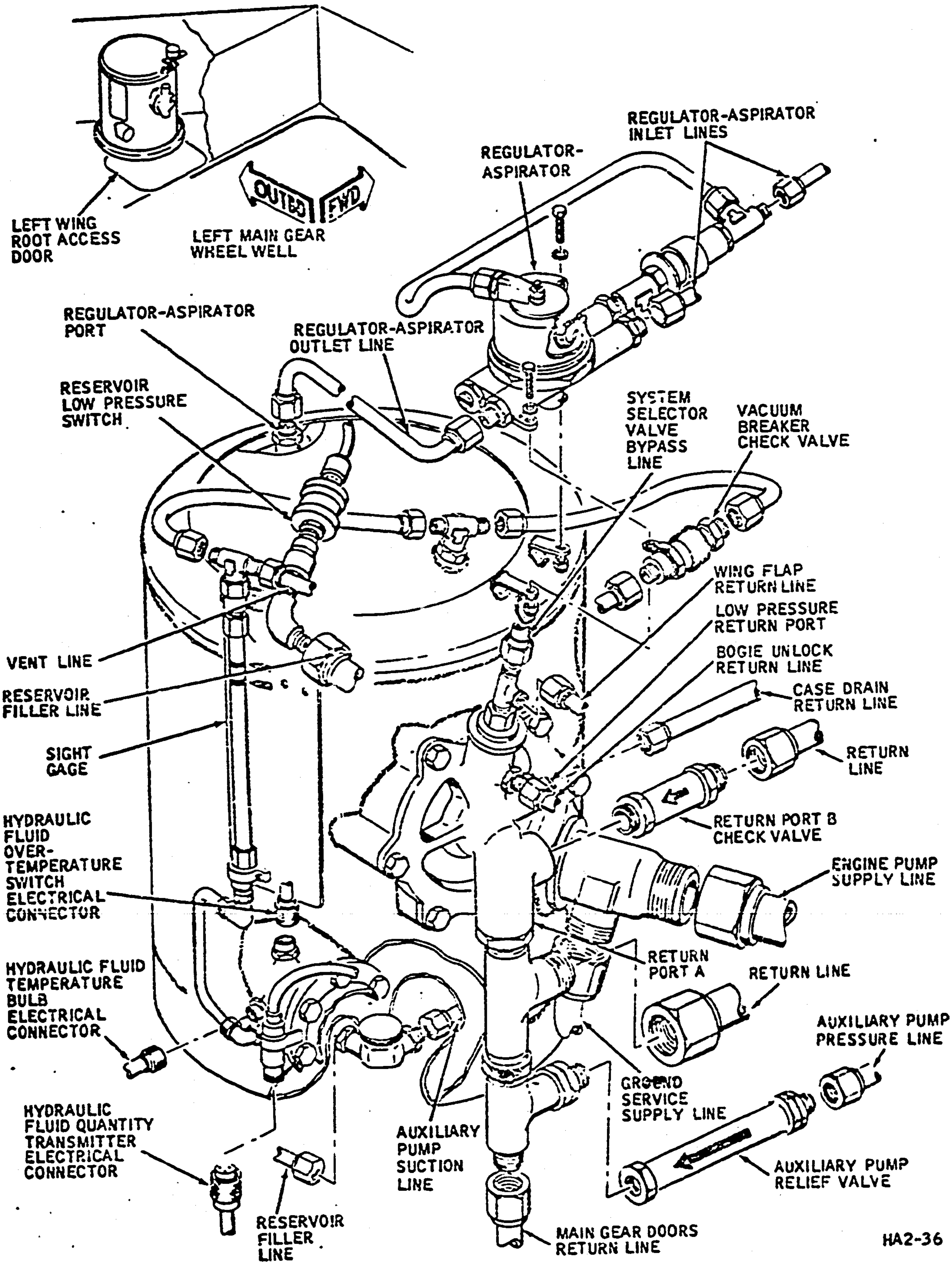
      (6) Disconnect line from high standpipe port at bottom of reservoir.

      (7) Disconnect lines from T-fitting at return port A.

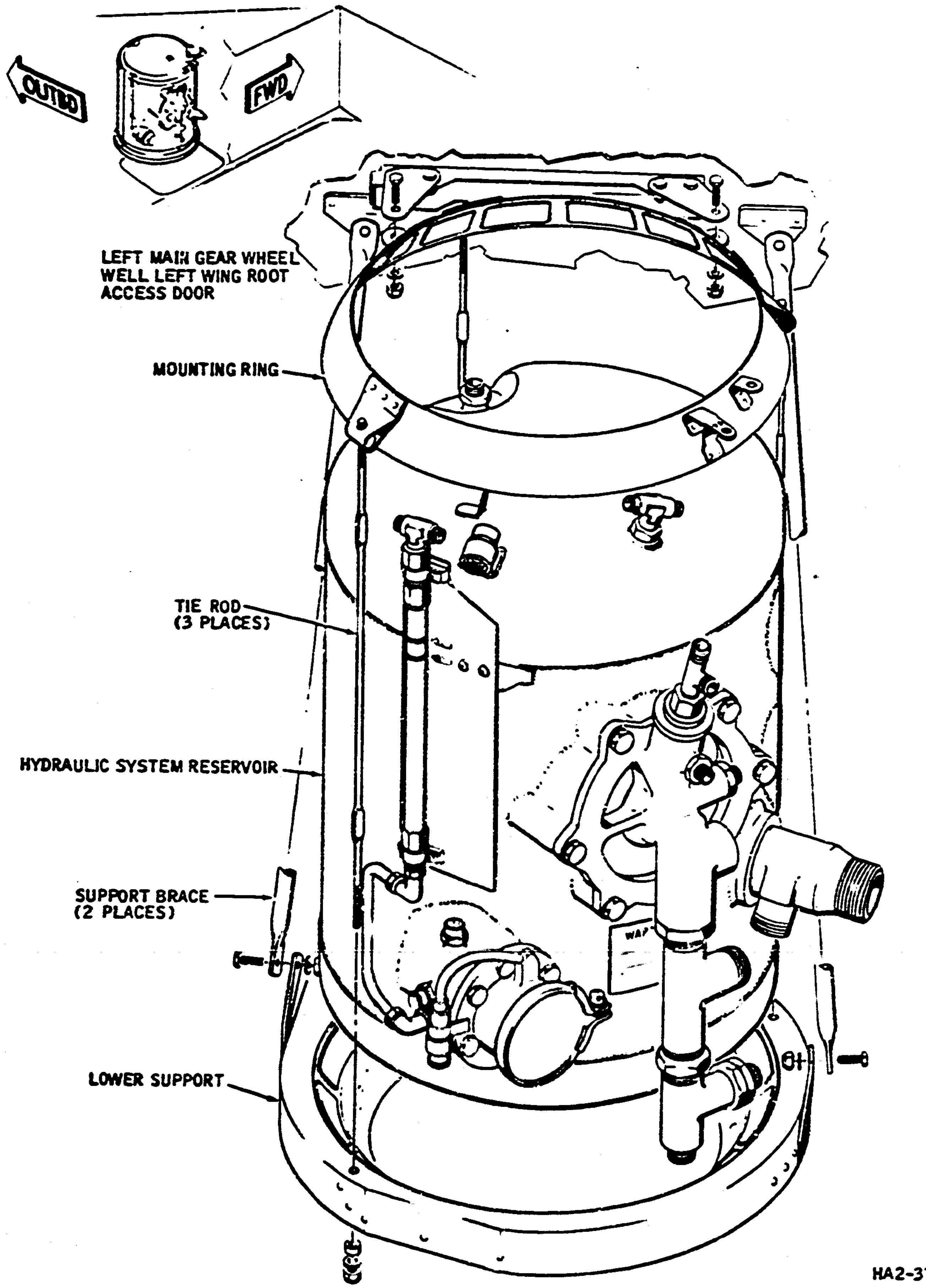
      (8) Disconnect line from check valve at return port B.

      (9) Disconnect line from low-pressure return port.

      (10) Disconnect lines from T-fitting at wing flap return port.



Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 1)



Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 2)

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(11) Disconnect line from bogie unlock return port.

(12) Disconnect reservoir filler vent line from T-fitting at top of sight gage.

(13) Remove lines from between following fittings:

(a) T-fitting on sight gage and reservoir

(b) T-fitting at top of reservoir and vacuum breaker check valve.

(c) Regulator-aspirator outlet port and reservoir.

(14) Remove vacuum breaker check valve.

(15) Disconnect inlet lines from regulator-aspirator and remove regulator-aspirator (see 29-10-3).

(16) Disconnect line from filler port.

(17) Disconnect lines from T-fitting at normal supply port.

(18) Disconnect electrical connectors from hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicator light switch, hydraulic fluid quantity transmitter, and reservoir low-pressure switch.

(19) Remove bolts securing mounting ring to structure.

(20) Remove bolts securing mounting ring to lower support. Remove mounting ring and pad.

(21) Remove clamps which attach main gear door manual open valve hydraulic line to lower support.

(22) Disconnect braces and lower support structure attachment. Lift reservoir, and remove lower support and then remove reservoir through wing root access door.

(23) Remove check valve, relief valves, and fittings from reservoir ports; retain for use on new reservoir.

B. Install Reservoir

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

(2) Using new O-rings, install all check valves, relief valves, and fittings in reservoir ports.

(3) Make certain that magnetic drain plug is tightened to torque of 312 (±20) inch-pounds. Safety plug with lockwire.

(4) Install new pad in reservoir lower support and mounting ring if required.

(5) Place reservoir in wing root access area, place lower support under reservoir, and secure lower support in place.

(6) Install mounting ring and secure rods to lower support.

(7) Secure mounting ring to structure.

(8) Install clamps which attach main gear door manual open valve hydraulic line to lower support.

(9) Connect electrical connectors to hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicating light switch, hydraulic fluid quantity transmitter, and reservoir low-pressure switch.

(10) Connect lines to T-fitting in normal supply port.

(11) Connect line to filler port at top of reservoir.

(12) Install regulator-aspirator and connect inlet lines to regulator-aspirator (see 29-10-3).

(13) Install vacuum breaker check valve.

(14) Install lines between following fittings:

(a) Regulator-aspirator outlet port and reservoir

(b) Vacuum breaker check valve and T-fitting at top of reservoir

(c) T-fitting at top of reservoir and T-fitting on sight gage

(15) Connect reservoir filler vent line to T-fitting on sight gage.

(16) Connect line to bogie unlock return port.

(17) Connect line to wing flap return port.

(18) Connect line to low-pressure return port.

(19) Connect line to check valve installed in return port B.

(20) Connect lines to T-fittings at return port A.

(21) Connect line to low standpipe port at bottom of reservoir.

(22) Connect line to high standpipe port at bottom of reservoir.

(23) Fill reservoir as described on instruction placard on reservoir.

(24) Close following circuit breakers.

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

3. Inspection/Check Hydraulic System Reservoir

A. Check Reservoir

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Operate wing flaps through one complete cycle of operation.

<u>WARNING:</u> MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(4) Check reservoir low-pressure air gage, located adjacent to air bleed valve in left wheel well, for 30 to 35 psi air pressure indication.

(5) Check lines between reservoir and reservoir air pressure relief valve for air leaks.

(6) Check all lines and fittings on reservoir for hydraulic leaks.

(7) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(8) Check all reservoir lines for security of connections and clearance between lines and adjacent components and structure.

(9) Check all electrical connectors for security of attachment.

(10) Check magnetic drain plug for security of installation and lockwire.

(11) Check reservoir fluid level and fill if necessary as described on instruction placard on reservoir.

HYDRAULIC SYSTEM RESERVOIR - MAINTENANCE PRACTICES

1. General

A. The hydraulic system reservoir is located on the aft side of the rear spar in the left wing root.

B. Access is through the left wing root access door.

2. Removal/Installation Hydraulic System Reservoir

A. Remove Reservoir

(1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

(2) Depressurize hydraulic system (29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect line from low standpipe port at bottom of reservoir.

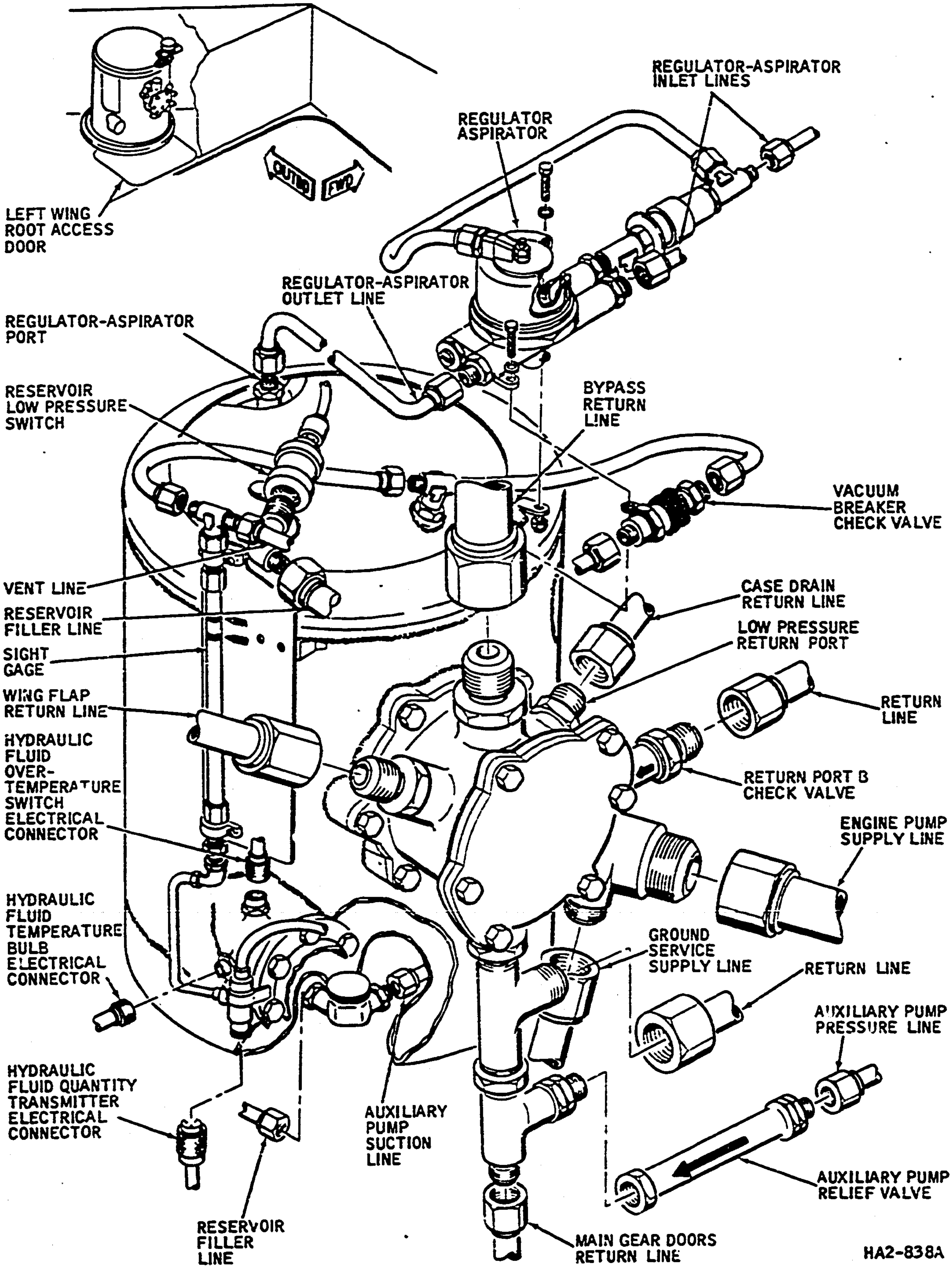
(6) Disconnect line from high standpipe port at bottom of reservoir.

(7) Disconnect lines from T-fitting at return port A.

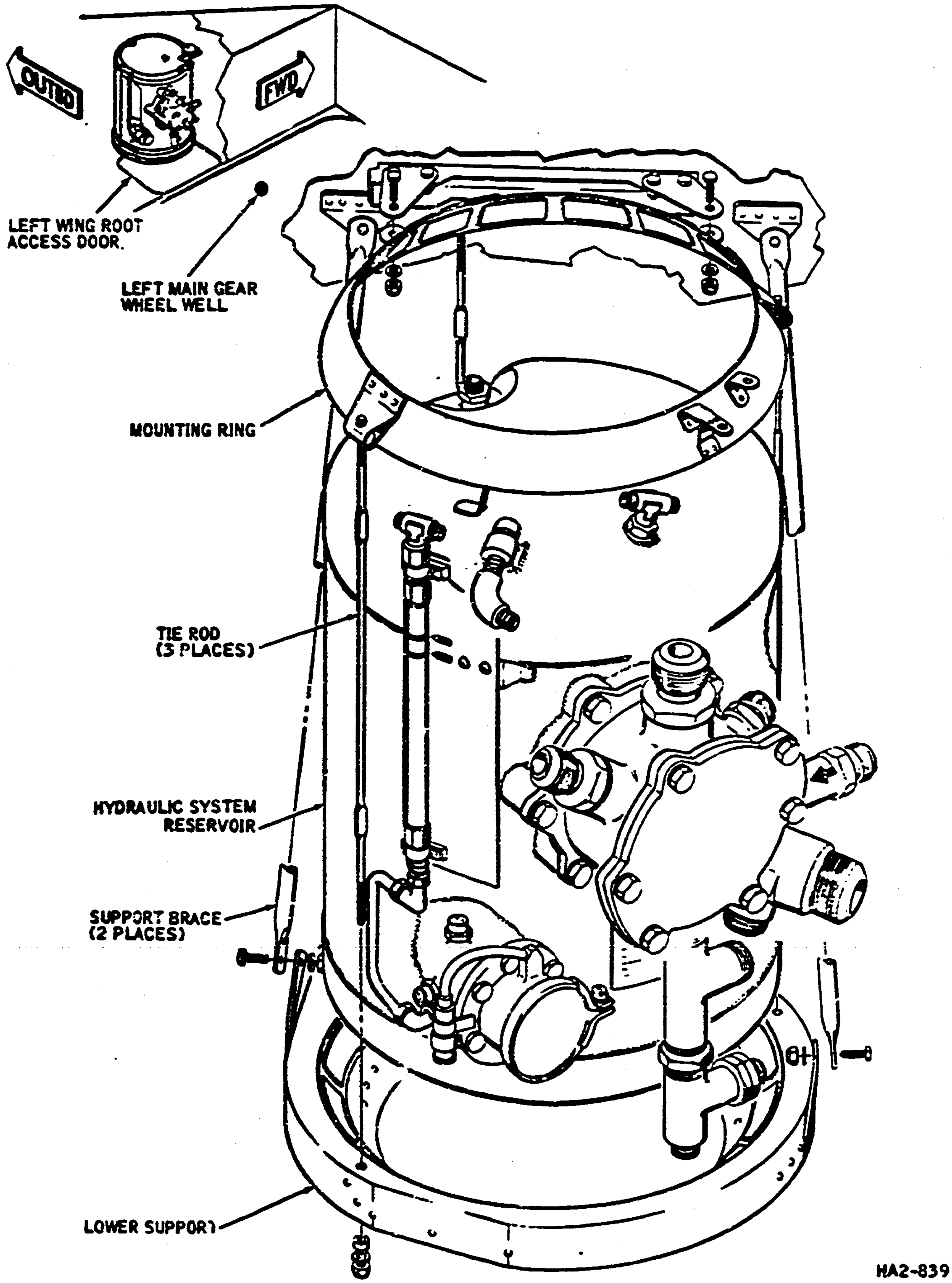
(8) Disconnect line from check valve at return port B.

(9) Disconnect line from low-pressure return port.

(10) Disconnect lines from T-fitting at wing flap return port.



Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 1)



Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 2)

(11) Disconnect line from bypass port.

(12) Disconnect reservoir filler vent line from T-fitting at top of sight gage.

(13) Remove lines from between following fittings:

(a) T-fitting on sight gage and reservoir

(b) T-fitting at top of reservoir and vacuum breaker check valve

(c) Regulator-aspirator outlet port and reservoir

(14) Remove vacuum breaker check valve.

(15) Disconnect inlet lines from regulator-aspirator and remove regulator-aspirator (see 29-10-3).

(16) Disconnect line from filler port.

(17) Disconnect lines from T-fitting at normal supply port.

(18) Disconnect electrical connectors from hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicator light switch, hydraulic fluid quantity transmitter, and reservoir low-pressure switch.

(19) Remove bolts securing mounting ring to structure.

(20) Remove bolts securing mounting ring to lower support. Remove mounting ring and pad.

(21) Remove clamps which attach main gear door manual open valve hydraulic line to lower support.

(22) Disconnect braces and lower support structure attachment. Lift reservoir, and remove lower support and then remove reservoir through wing root access door.

(23) Remove check valve, relief valves, and fittings from reservoir ports; retain for use on new reservoir.

B. Install Reservoir

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

(2) Using new O-rings, install all check valves, relief valves, and fittings in reservoir ports.

(3) Make certain that magnetic drain plug is tightened to torque of 312 (±20) inch-pounds. Safety plug with lockwire.

(4) Install new pad in reservoir lower support and mounting ring if required.

(5) Place reservoir in wing root access area, place lower support under reservoir, and secure lower support in place.

(6) Install mounting ring and secure rods to lower support.

(7) Secure mounting ring to structure.

(8) Install clamps which attach main gear door manual open valve hydraulic line to lower support.

(9) Connect electrical connectors to hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicating light switch, hydraulic fluid quantity transmitter, and reservoir low-pressure switch.

(10) Connect lines to T-fitting in normal supply port.

(11) Connect line to filler port at top of reservoir.

(12) Install regulator-aspirator and connect inlet lines to regulator-aspirator (see 29-10-3).

(13) Install vacuum breaker check valve.

(14) Install lines between following fittings:

(a) Regulator-aspirator outlet port and reservoir

(b) Vacuum breaker check valve and T-fitting at top of reservoir

(c) T-fitting at top of reservoir and T-fitting on sight gage

(15) Connect reservoir filler vent line to T-fitting on sight gage.

(16) Connect line to bypass port.

(17) Connect lines to wing flap return port.

(18) Connect line to low-pressure return port.

(19) Connect line to check valve installed in return port B.

(20) Connect lines to T-fittings at return port A.

(21) Connect line to low standpipe port at bottom of reservoir.

(22) Connect line to high standpipe port at bottom of reservoir.

(23) Fill reservoir as described on instruction placard on reservoir.

(24) Close following circuit breakers.

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

3. Inspection/Check Hydraulic System Reservoir

A. Check Reservoir

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Operate wing flaps through one complete cycle of operation.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(4) Check reservoir low-pressure air gage, located adjacent to air bleed valve in left wheel well, for 30 to 35 psi air pressure indication.

(5) Check lines between reservoir and reservoir air pressure relief valve for air leaks.

(6) Check all lines and fittings on reservoir for hydraulic leaks.

(7) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(8) Check all reservoir lines for security of connections and clearance between lines and adjacent components and structure.

(9) Check all electrical connectors for security of attachment.

(10) Check magnetic drain plug for security of installation and lockwire.

(11) Check reservoir fluid level and fill if necessary as described in instruction placard on reservoir.

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HYDRAULIC SYSTEM RESERVOIR - MAINTENANCE PRACTICES

1. General

   A. The hydraulic system reservoir is located on the aft side of the rear spar in the left wing root.

   B. Access is through the left wing root access door.

2. Removal/Installation Hydraulic System Reservoir

   A. Remove Reservoir

      (1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

      WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect line from low standpipe port at bottom of reservoir.

      (6) Disconnect line from high standpipe port at bottom of reservoir.

      (7) Disconnect lines from T-fitting at return port A.

      (8) Disconnect line from check valve at return port B.

      (9) Disconnect line from low-pressure return port.

      (10) Disconnect lines from T-fitting at wing flap return port.

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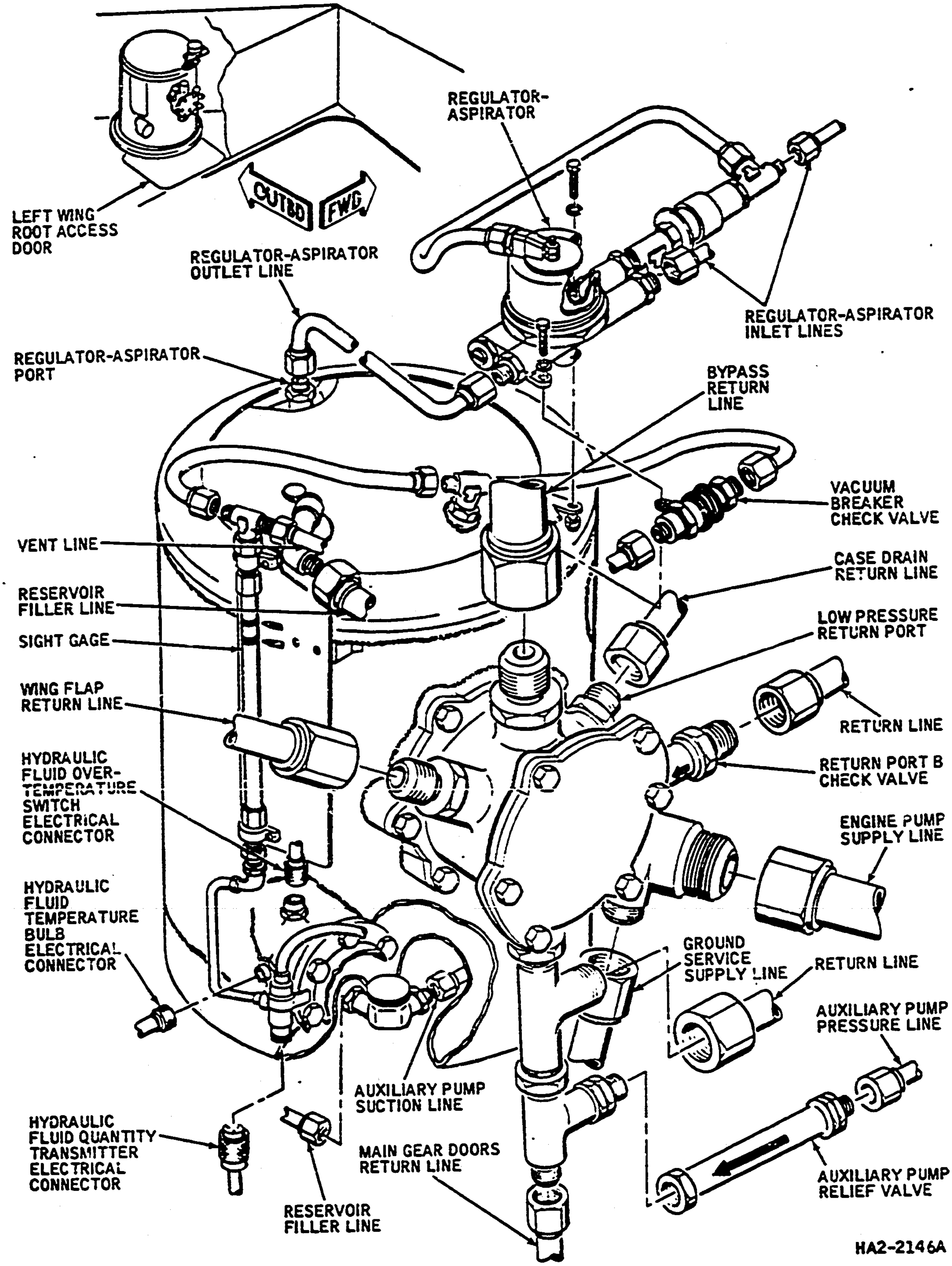
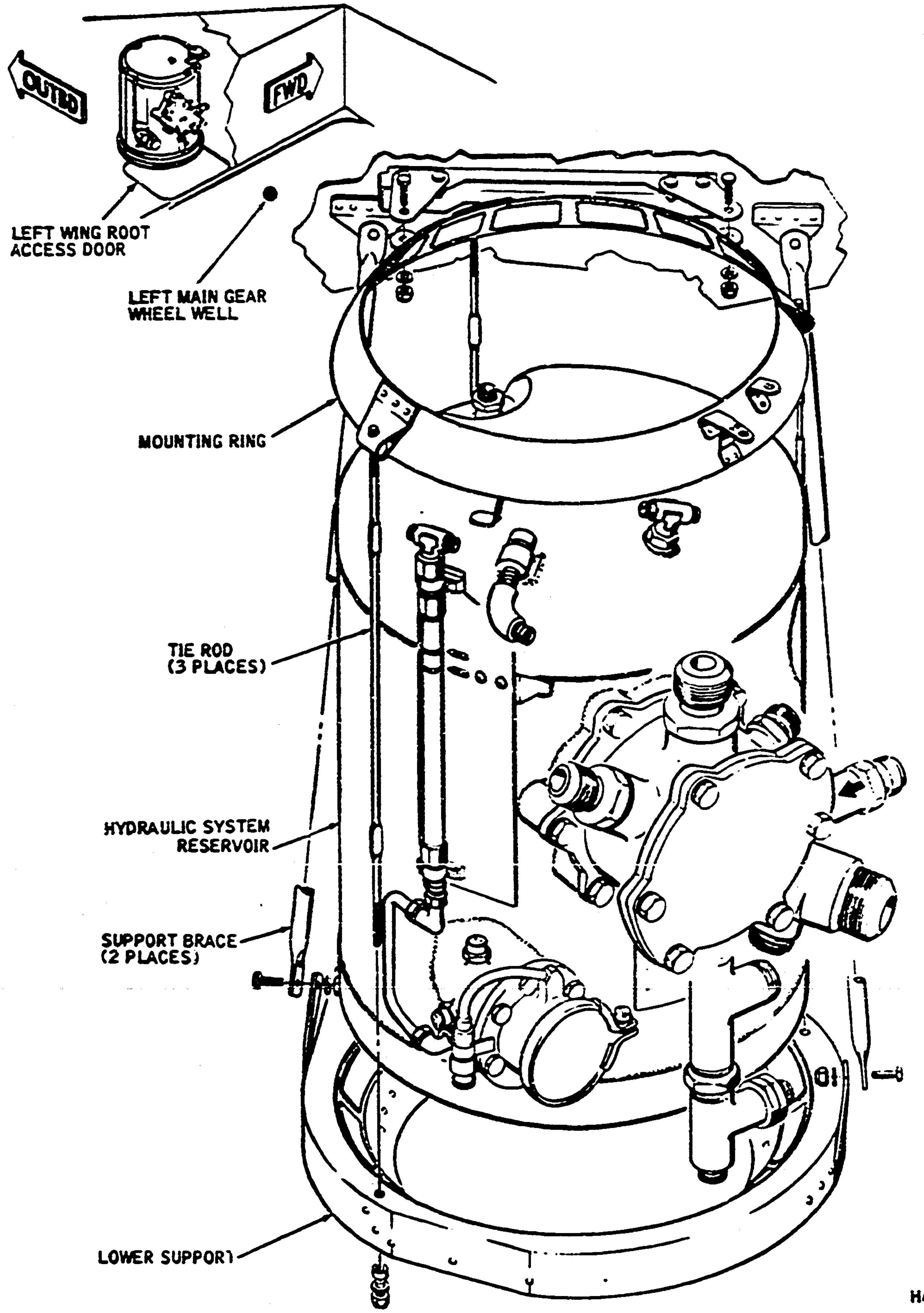


Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 1)



Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 2)

(11) Disconnect line from bypass port.

(12) Disconnect reservoir filler vent line from T-fitting at top of sight gage.

(13) Remove lines from between following fittings:

(a) T-fitting on sight gage and reservoir

(b) T-fitting at top of reservoir and vacuum breaker check valve

(c) Regulator-aspirator outlet port and reservoir.

(14) Remove vacuum breaker check valve.

(15) Disconnect inlet lines from regulator-aspirator and remove regulator-aspirator (see 29-10-3).

(16) Disconnect line from filler port.

(17) Disconnect lines from T-fitting at normal supply port.

(18) Disconnect electrical connectors from hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicator light switch, and hydraulic fluid quantity transmitter.

(19) Remove bolts securing mounting ring to structure.

(20) Remove bolts securing mounting ring to lower support. Remove mounting ring and pad.

(21) Remove clamps which attach main gear door manual open valve hydraulic line to lower support.

(22) Disconnect braces and lower support structure attachment. Lift reservoir, and remove lower support and then remove reservoir through wing root access door.

(23) Remove check valve, relief valves, and fittings from reservoir ports; retain for use on new reservoir.

B. Install Reservoir

(1) Make certain that following circuit breakers located on EPC circuit breaker panel are open:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

(2) Using new O-rings, install all check valves, relief valves, and fittings in reservoir ports.

(3) Make certain that magnetic drain plug is tightened to torque of 312 (±20) inch-pounds. Safety plug with lockwire.

(4) Install new pad in reservoir lower support and mounting ring if required.

(5) Place reservoir in wing root access area, place lower support under reservoir, and secure lower support in place.

(6) Install mounting ring and secure rods to lower support.

(7) Secure mounting ring to structure.

(8) Install clamps which attach main gear door manual open valve hydraulic line to lower support.

(9) Connect electrical connectors to hydraulic fluid temperature bulb. hydraulic fluid overtemperature indicating light switch, and hydraulic fluid quantity transmitter.

(10) Connect lines to T-fitting in normal supply port.

(11) Connect line to filler port at top of reservoir.

(12) Install regulator-aspirator and connect inlet lines to regulator-aspirator (see 29-10-3).

(13) Install vacuum breaker check valve.

(14) Install lines between following fittings:

(a) Regulator-aspirator outlet port and reservoir

(b) Vacuum breaker check valve and T-fitting at top of reservoir

(c) T-fitting at top of reservoir and T-fitting on sight gage

(15) Connect reservoir filler vent line to T-fitting on sight gage.

(16) Connect line to bypass port.

(17) Connect lines to wing flap return port.

(18) Connect line to low-pressure return port.

(19) Connect line to check valve installed in return port B.

(20) Connect lines to T-fittings at return port A.

(21) Connect line to low standpipe port at bottom of reservoir.

(22) Connect line to high standpipe port at bottom of reservoir.

(23) Fill reservoir as described on instruction placard on reservoir.

(24) Close following circuit breakers.

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

3. <u>Inspection/Check Hydraulic System Reservoir</u>

A. Check Reservoir

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

<u>WARNING</u>: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Operate wing flaps through one complete cycle of operation.

<u>WARNING</u>: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(4) Check reservoir low-pressure air gage, located adjacent to air bleed valve in left wheel well, for 30 to 35 psi air pressure indication.

(5) Check lines between reservoir and reservoir air pressure relief valve for air leaks.

(6) Check all lines and fittings on reservoir for hydraulic leaks.

(7) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(8) Check all reservoir lines for security of connections and clearance between lines and adjacent components and structure.

(9) Check all electrical connectors for security of attachment.

(10) Check magnetic drain plug for security of installation and lockwire.

(11) Check reservoir fluid level and fill if necessary as described c. instruction placard on reservoir.

HYDRAULIC SYSTEM RESERVOIR - MAINTENANCE PRACTICES

1. General

A. The hydraulic system reservoir is located on the aft side of the rear spar in the left wing root.

B. Access is through the left wing root access door.

2. Removal/Installation Hydraulic System Reservoir

A. Remove Reservoir

(1) Open following circuit breakers:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect line from low standpipe port at bottom of reservoir.

(6) Disconnect line from high standpipe port at bottom of reservoir.

(7) Disconnect lines from T-fitting at return port A.

(8) Disconnect line from check valve at return port B.

(9) Disconnect line from low-pressure return port.

(10) Disconnect lines from T-fitting at wing flap return port.

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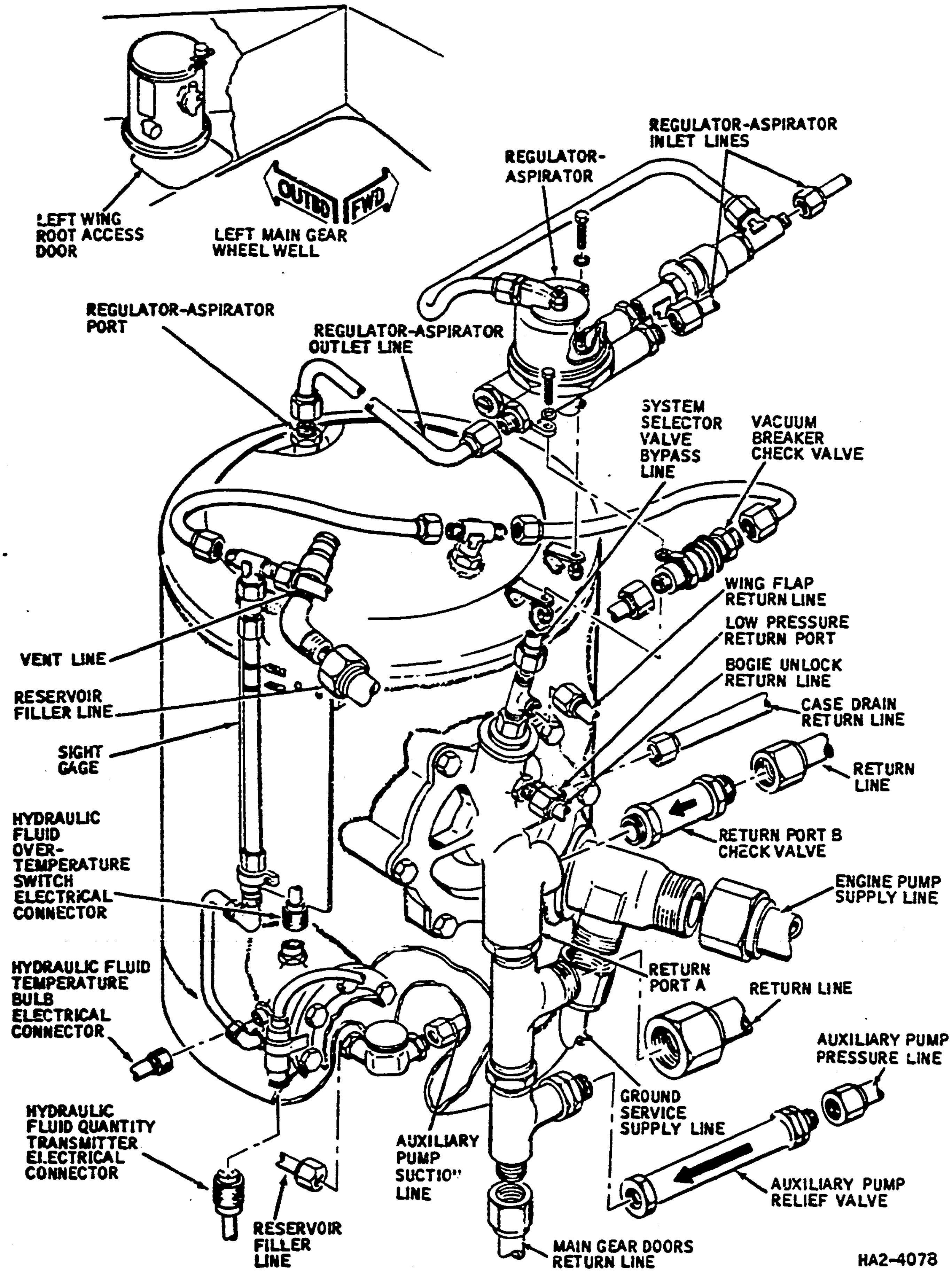
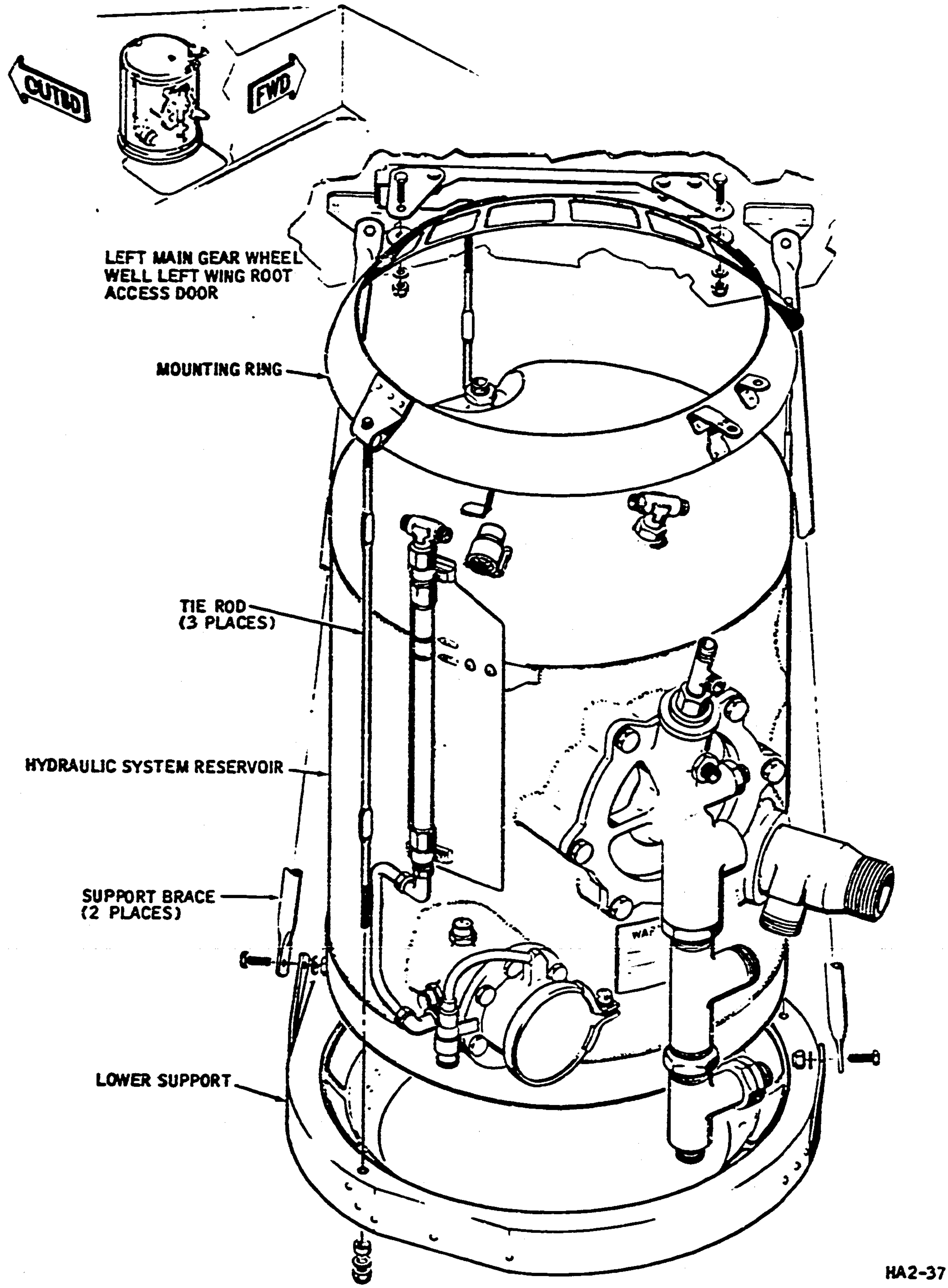


Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 1)



Hydraulic System Reservoir -- Installation
Figure 201 (Sheet 2)

(11) Disconnect line from bogie unlock return port.

(12) Disconnect reservoir filler vent line from T-fitting at top of sight gage.

(13) Remove lines from between following fittings:

(a) T-fitting on sight gage and reservoir

(b) T-fitting on top of reservoir and vacuum breaker check valve.

(c) Regulator-aspirator outlet port and reservoir.

(14) Remove vacuum breaker check valve.

(15) Disconnect inlet lines from regulator-aspirator and remove regulator-aspirator (see 29-10-3).

(16) Disconnect line from filler port.

(17) Disconnect lines from T-fitting at normal supply port.

(18) Disconnect electrical connectors from hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicator light switch, and hydraulic fluid quantity transmitter.

(19) Remove bolts securing mounting ring to structure.

(20) Remove bolts securing mounting ring to lower support. Remove mounting ring and pad.

(21) Remove clamps which attach main gear door manual open valve hydraulic line to lower support.

(22) Disconnect braces and lower support structure attachment. Lift reservoir and remove lower support and then remove reservoir through wing root access door.

(23) Remove check valve, relief valves, and fittings from reservoir ports; retain for use on new reservoir.

B. Install Reservoir

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

(2) Using new O-rings, install all check valves, relief valves, and fittings in reservoir ports.

(3) Make certain that magnetic drain plug is tightened to torque of 312 (±20) inch-pounds. Safety plug with lockwire.

(4) Install new pad in reservoir lower support and mounting ring if required.

(5) Place reservoir in wing root access area, place lower support under reservoir, and secure lower support in place.

(6) Install mounting ring and secure rods to lower support.

(7) Secure mounting ring to structure.

(8) Install clamps which attach main gear door manual open valve hydraulic line to lower support.

(9) Connect electrical connectors to hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicating light switch, and hydraulic fluid quantity transmitter.

(10) Connect lines to T-fitting in normal supply port.

(11) Connect line to filler port at top of reservoir.

(12) Install regulator-aspirator and connect inlet lines to regulator-aspirator (see 29-10-3).

(13) Install vacuum breaker check valve.

(14) Install lines between following fittings:

(a) Regulator-aspirator outlet port and reservoir

(b) Vacuum breaker check valve and T-fitting at top of reservoir

(c) T-fitting at top of reservoir and T-fitting on sight gage

(15) Connect reservoir filler vent line to T-fitting on sight gage.

(16) Connect line to bogie unlock return port.

(17) Connect lines to wing flap return port.

(18) Connect line to low-pressure return port.

(19) Connect line to check valve installed in return port B.

(20) Connect lines to T-fittings at return port A.

(21) Connect line to low standpipe port at bottom of reservoir.

(22) Connect line to high standpipe port at bottom of reservoir.

(23) Fill reservoir as described on instruction placard on reservoir.

(24) Close following circuit breakers.

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

3. Inspection/Check Hydraulic System Reservoir

A. Check Reservoir

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Operate wing flaps through one complete cycle of operation.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(4) Check reservoir low-pressure air gage, located adjacent to air bleed valve in left wheel well, for 30 to 35 psi air pressure indication.

(5) Check lines between reservoir and reservoir air pressure relief valve for air leaks.

(6) Check all lines and fittings on reservoir for hydraulic leaks.

(7) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(8) Check all reservoir lines for security of connections and clearance between lines, and adjacent components and structure.

(9) Check all electrical connectors for security of attachment.

(10) Check magnetic drain plug for security of installation and lockwire.

(11) Check reservoir fluid level and fill if necessary as described on instruction placard on reservoir.

HYDRAULIC SYSTEM RESERVOIR - MAINTENANCE PRACTICES

1. General

   A. The hydraulic system reservoir is located on the aft side of the rear spar in the left wing root.

   B. Access is through the left wing root access door.

2. Removal/Installation Hydraulic System Reservoir

   A. Remove Reservoir

      (1) Open following circuit breakers:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect line from low standpipe port at bottom of reservoir.

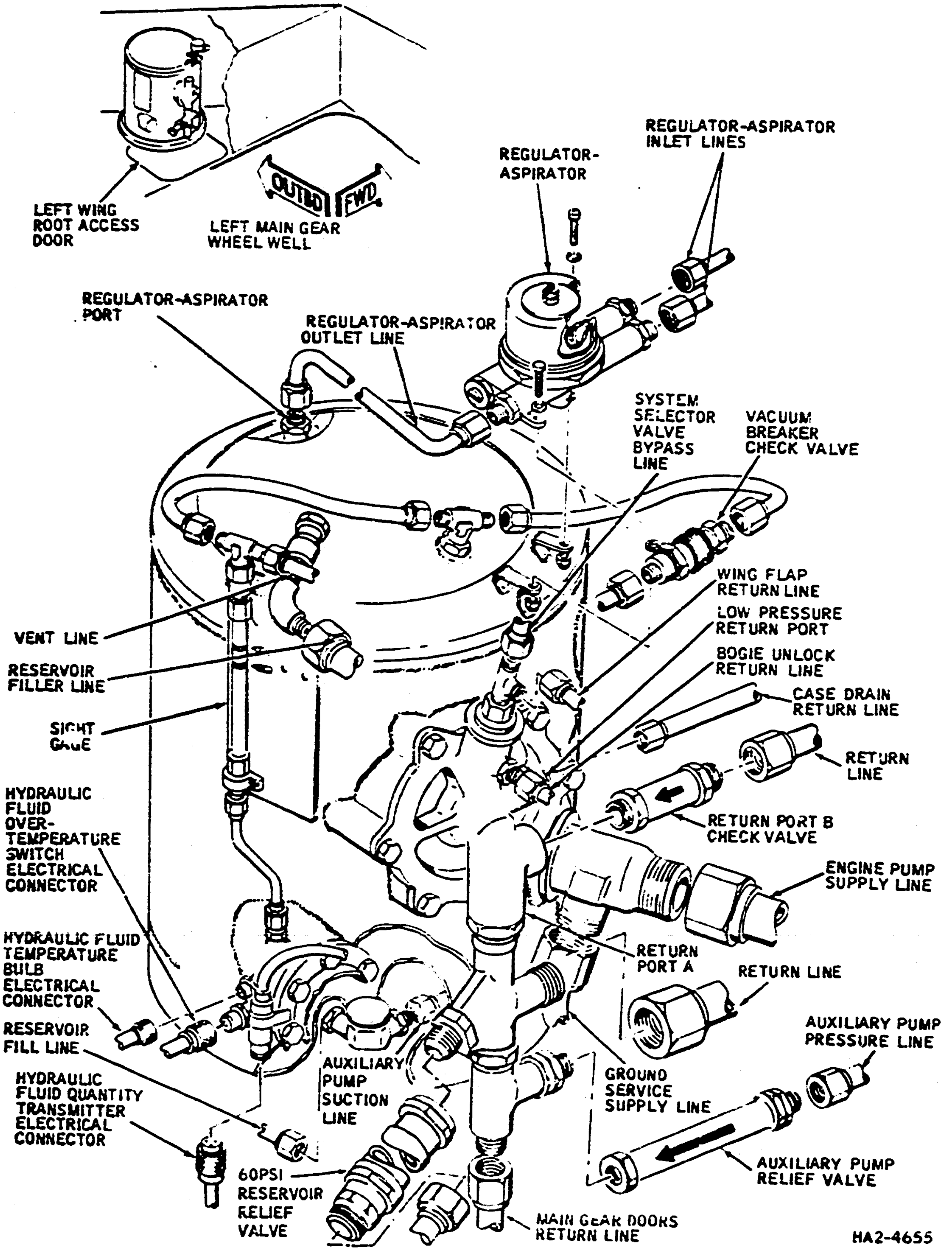
      (6) Disconnect line from high standpipe port at bottom of reservoir.

      (7) Disconnect lines from fittings at return port A.

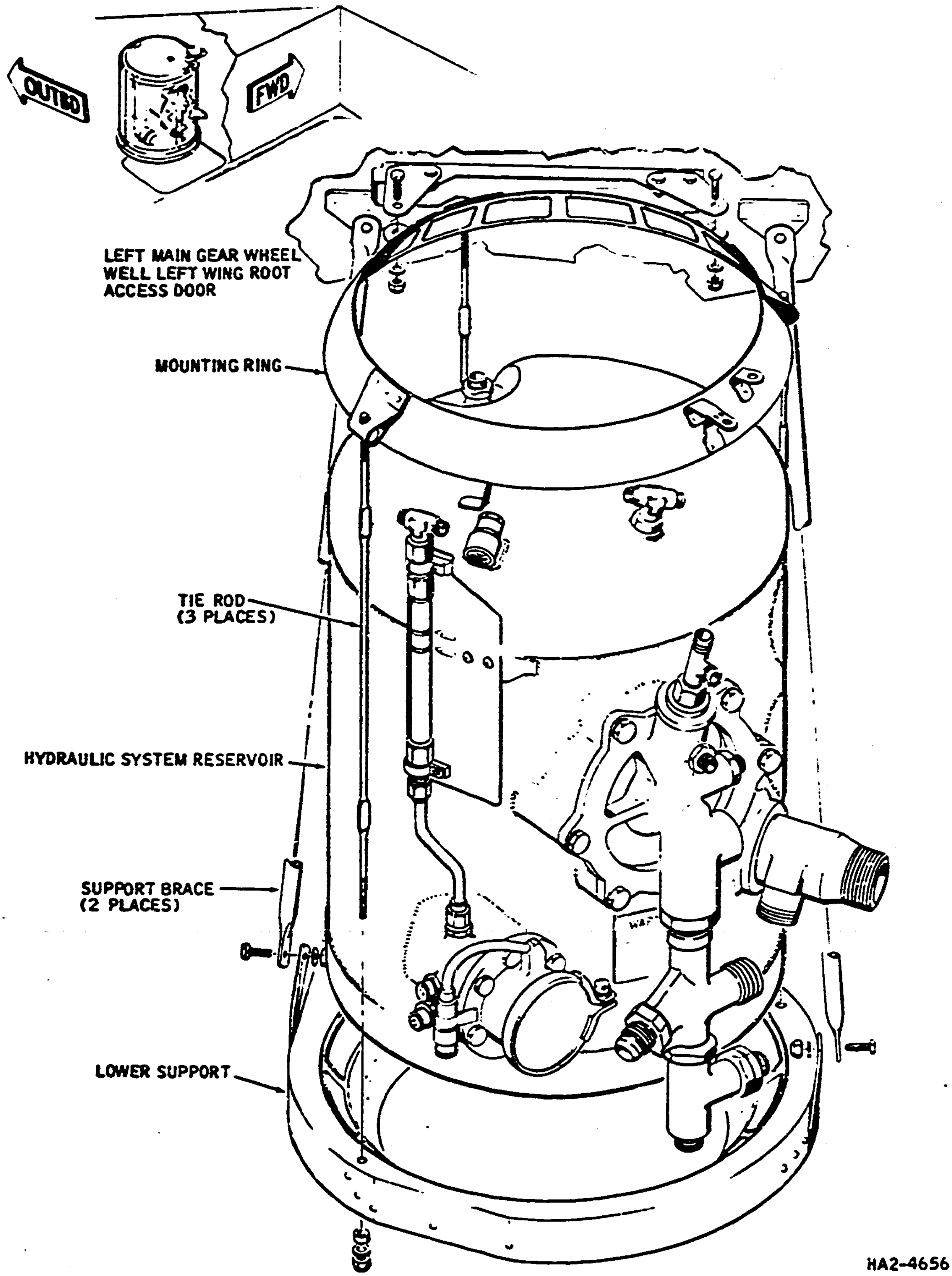
      (8) Disconnect line from check valve at return port B.

      (9) Disconnect line from low-pressure return port.

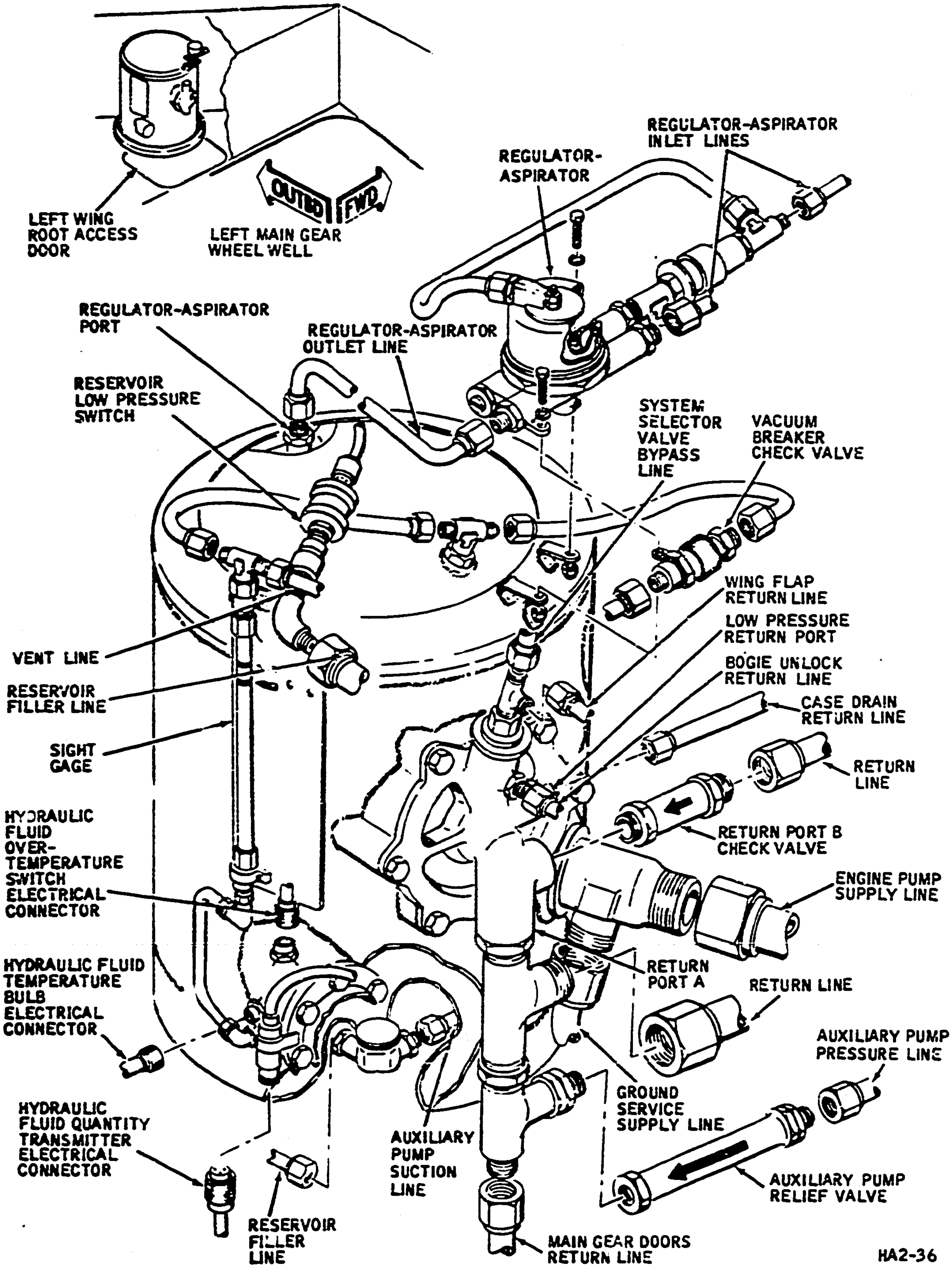
      (10) Disconnect lines from T-fitting at wing flap return port.



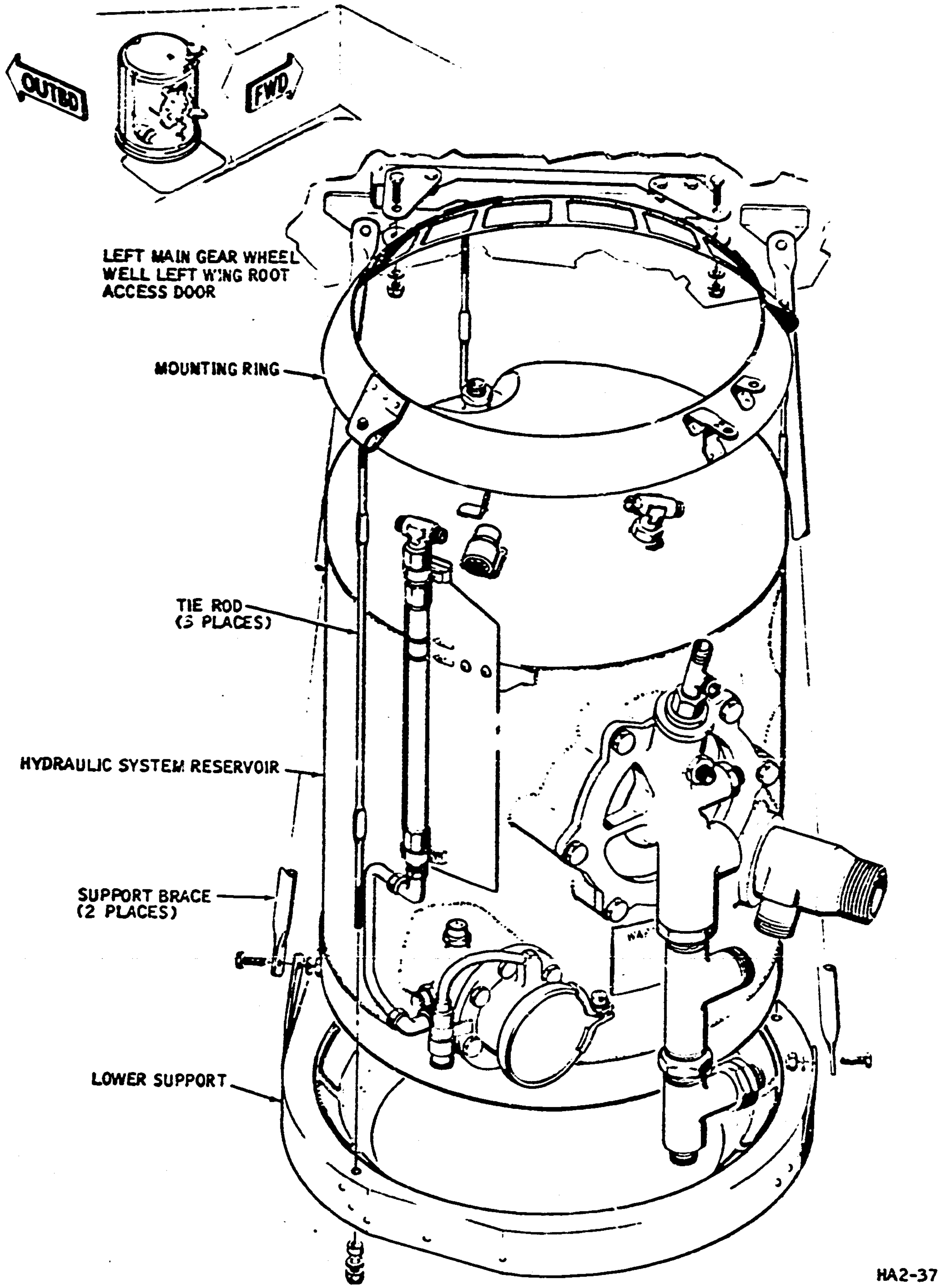
Hydraulic System Reservoir -- Installation
(Airplanes 801-811)
Figure 201 (Sheet 1)



Hydraulic System Reservoir -- Installation
(Airplanes 801-811)
Figure 201 (Sheet 2)



Hydraulic System Reservoir -- Installation
(Airplanes 812-822, 860-863)
Figure 201 (Sheet 3)



Hydraulic System Reservoir -- Installation
(Airplanes 812-822, 860-863)
Figure 201 (Sheet 4)

(11) Disconnect line from bogie unlock return port.

(12) Disconnect reservoir filler vent line from T-fitting at top of sight gage.

(13) Remove lines from between following fittings:

(a) T-fitting on sight gage and reservoir.

(b) T-fitting at top of reservoir and vacuum breaker check valve.

(c) Regulator-aspirator outlet port and reservoir.

(14) Remove vacuum breaker check valve.

(15) Disconnect inlet lines from regulator-aspirator and remove regulator-aspirator (see 29-10-3).

(16) Disconnect line from filler port.

(17) Disconnect lines from T-fitting at normal supply port.

(18) Disconnect electrical connectors from hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicator light switch, and hydraulic fluid quantity transmitter.

(19) Disconnect electrical connector from reservoir low pressure switch (airplanes 812-819, 860-863).

(20) Remove bolts securing mounting ring to structure.

(21) Remove bolts securing mounting ring to lower support. Remove mounting ring and pad.

(22) Remove clamps which attach main gear door manual open valve hydraulic line to lower support.

(23) Disconnect braces and lower support structure attachment. Lift reservoir, and remove lower support and then remove reservoir through wing root access door.

(24) Remove check valve, relief valves, and fittings from reservoir ports; retain for use on new reservoir.

B. Install Reservoir

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

(2) Using new O-rings, install all check valves, relief valves, and fittings in reservoir ports.

(3) Make certain that magnetic drain plug is tightened to torque of 312 (±20) inch-pounds. Safety plug with lockwire.

(4) Install new pad in reservoir lower support and mounting ring if required.

(5) Place reservoir in wing root access area, place lower support under reservoir, and secure lower support in place.

(6) Install mounting ring and secure rods to lower support.

(7) Secure mounting ring to structure.

(8) Install clamps which attach main gear door manual open valve hydraulic line to lower support.

(9) Connect electrical connectors to hydraulic fluid temperature bulb, hydraulic fluid overtemperature indicating light switch, and hydraulic fluid quantity transmitter.

(10) Connect electrical connector to reservoir low pressure switch (airplanes 812-819, 860-863).

(11) Connect lines to T-fitting in normal supply port.

(12) Connect line to filler port at top of reservoir.

(13) Install regulator-aspirator and connect inlet lines to regulator-aspirator (see 29-10-3).

(14) Install vacuum breaker check valve.

(15) Install lines between following fittings:

(a) Regulator-aspirator outlet port and reservoir

(b) Vacuum breaker check valve and T-fitting at top of reservoir

(c) T-fitting at top of reservoir and T-fitting on sight gage

(16) Connect reservoir filler vent line to T-fitting on sight gage.

(17) Connect line to bogie unlock return port.

(18) Connect line to wing flap return port.

(19) Connect line to low-pressure return port.

(20) Connect line to check valve installed in return port B.

(21) Connect lines to fittings at return port A.

(22) Connect line to low standpipe port at bottom of reservoir.

(23) Connect line to high standpipe port at bottom of reservoir.

(24) Fill reservoir as described on instruction placard on reservoir.

(25) Close following circuit breakers.

Circuit Breaker	Panel Section
Auxiliary hydraulic pump control	Cabin bus 4
Hydraulic oil temperature and quantity	Miscellaneous (dc bus)
Hydraulic system overtemperature rudder and aileron	Miscellaneous (dc bus)

3. Inspection/Check Hydraulic System Reservoir

A. Check Reservoir

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Operate wing flaps through one complete cycle of operation.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(4) Check reservoir low-pressure air gage, located adjacent to air bleed valve in left wheel well, for 35 to 40 psi on airplanes 801-815 or 30 to 35 psi on airplanes 816-819, 860-863, air pressure indication.

(5) Check lines between reservoir and reservoir air pressure relief valve for air leaks.

(6) Check all lines and fittings on reservoir for hydraulic leaks.

(7) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(8) Check all reservoir lines for security of connections and clearance between lines and adjacent components and structure.

(9) Check all electrical connectors for security of attachment.

(10) Check magnetic drain plug for security of installation and lockwire.

(11) Check reservoir fluid level and fill if necessary as described on instruction placard on reservoir.

HYDRAULIC RESERVOIR RETURN FLUID FILTER - MAINTENANCE PRACTICES

1. General

   A. The reservoir return fluid filter is located in the side of the hydraulic system reservoir, under the return ports manifold.

   B. Access to the return fluid filter is through the left wing root access door.

2. Tools and Equipment Required

   A. Antiseize compound (Federal Specification TT-A-580, JAN-A-667) is used on bolts for installation of hydraulic reservoir return fluid filter.

3. Removal/Installation Hydraulic Reservoir Return Fluid Filter

   A. Remove Return Fluid Filter

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect lines from T-fitting at return port A.

      (6) Disconnect lines from T-fitting at wing flap return port.

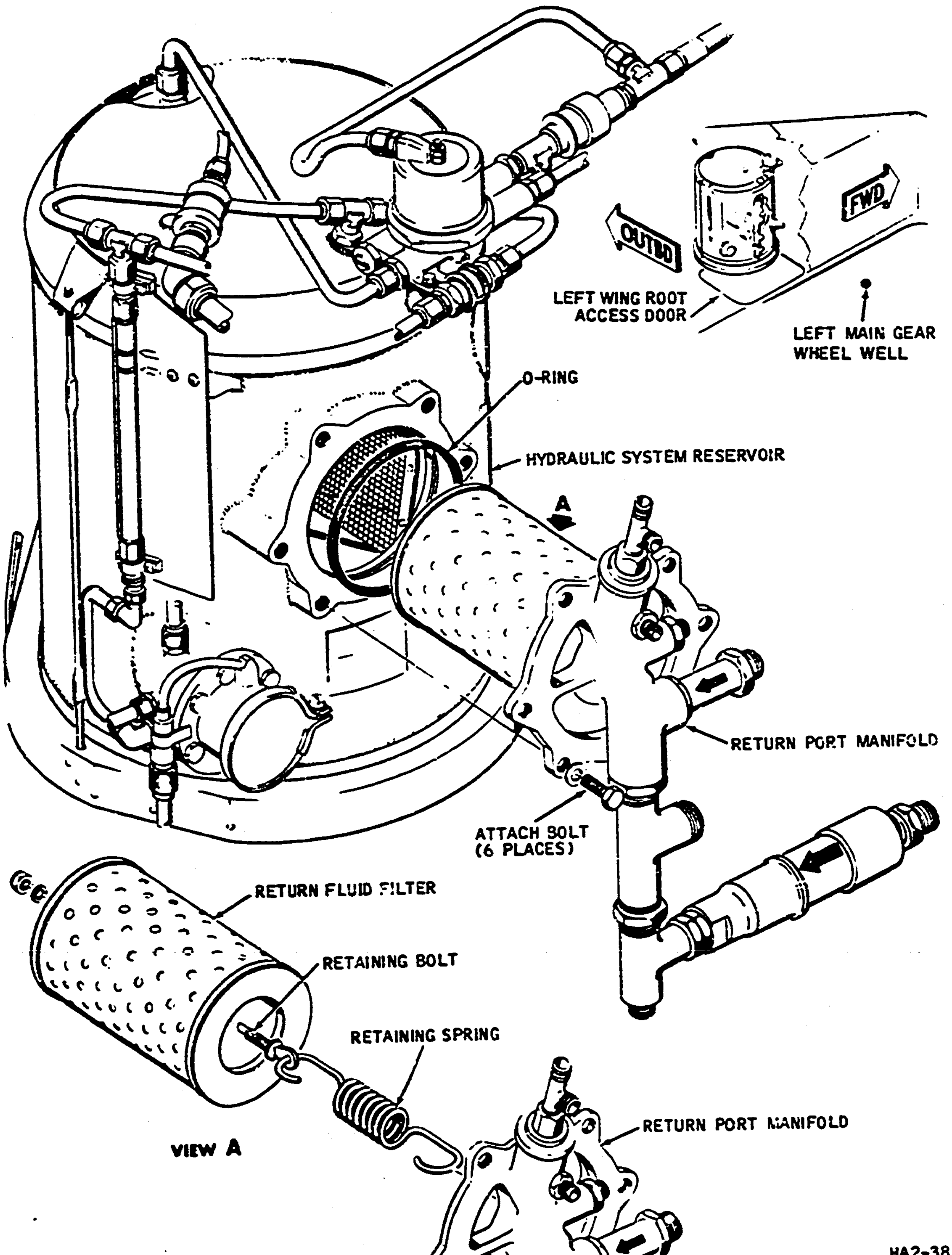
      (7) Disconnect line from check valve at return port B.

      (8) Disconnect line from low-pressure return port.

      (9) Disconnect line from bogie unlock return port.

      (10) Remove bolts from return port manifold and remove manifold.

      NOTE: Reservoir return fluid filter is attached to return ports manifold.



Hydraulic Reservoir Return Fluid
Filter -- Installation
Figure 201

(11) Remove nut from spring-tension eyebolt which protrudes through filter end plate.

(12) Remove filter end plate and filter.

B. Install Return Fluid Filter

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Check new filter for general condition and cleanliness.

(3) Place new filter in position against manifold.

(4) Insert threaded end of eyebolt through hole in end plate and install nut; tighten until nut bottoms on eyebolt threads.

(5) Install new O-ring on manifold, insert filter into reservoir, and align bolt holes.

(6) Apply antiseize compound to bolts and install bolts. Tighten to torque of 66 inch-pounds. Safety bolts with lockwire.

(7) Connect case drain line to low-pressure return port.

(8) Connect return line to check valve at return port B.

(9) Connect bypass line and wing flap return line to T-fitting at wing flap return port.

(10) Connect return lines to T-fitting at return port A.

(11) Connect bogie unlock return line to bogie return port.

(12) Fill reservoir (see instruction placard on reservoir).

(13) Close auxiliary hydraulic pump control circuit breaker.

4. Inspection/Check Hydraulic Reservoir Return Fluid Filter

A. Check Return Fluid Filter

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check hydraulic lines and fittings to all ports of return ports manifold for general condition, security of attachment, routing clearance and leaks.

(3) Check return ports manifold flange gasket for leaks.

HYDRAULIC RESERVOIR RETURN FLUID FILTER - MAINTENANCE PRACTICES

1. General

   A. The reservoir return fluid filter is located in the side of the hydraulic system reservoir, where it is mounted to the reservoir return port manifold cover.

   B. Access to the return fluid filter is through the left wing root access door and removal of the cover from the reservoir return port manifold.

2. Tools and Equipment Required

   A. Antiseize compound (Federal Specification TT-A-580, JAN-A-667) is used on bolts for installation of hydraulic reservoir return fluid filter.

3. Removal/Installation Hydraulic Reservoir Return Fluid Filter

   A. Remove Return Fluid Filter

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20)

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Remove bolts from return port manifold cover and remove cover from manifold.

      NOTE: Reservoir return fluid filter is attached to return ports manifold cover.

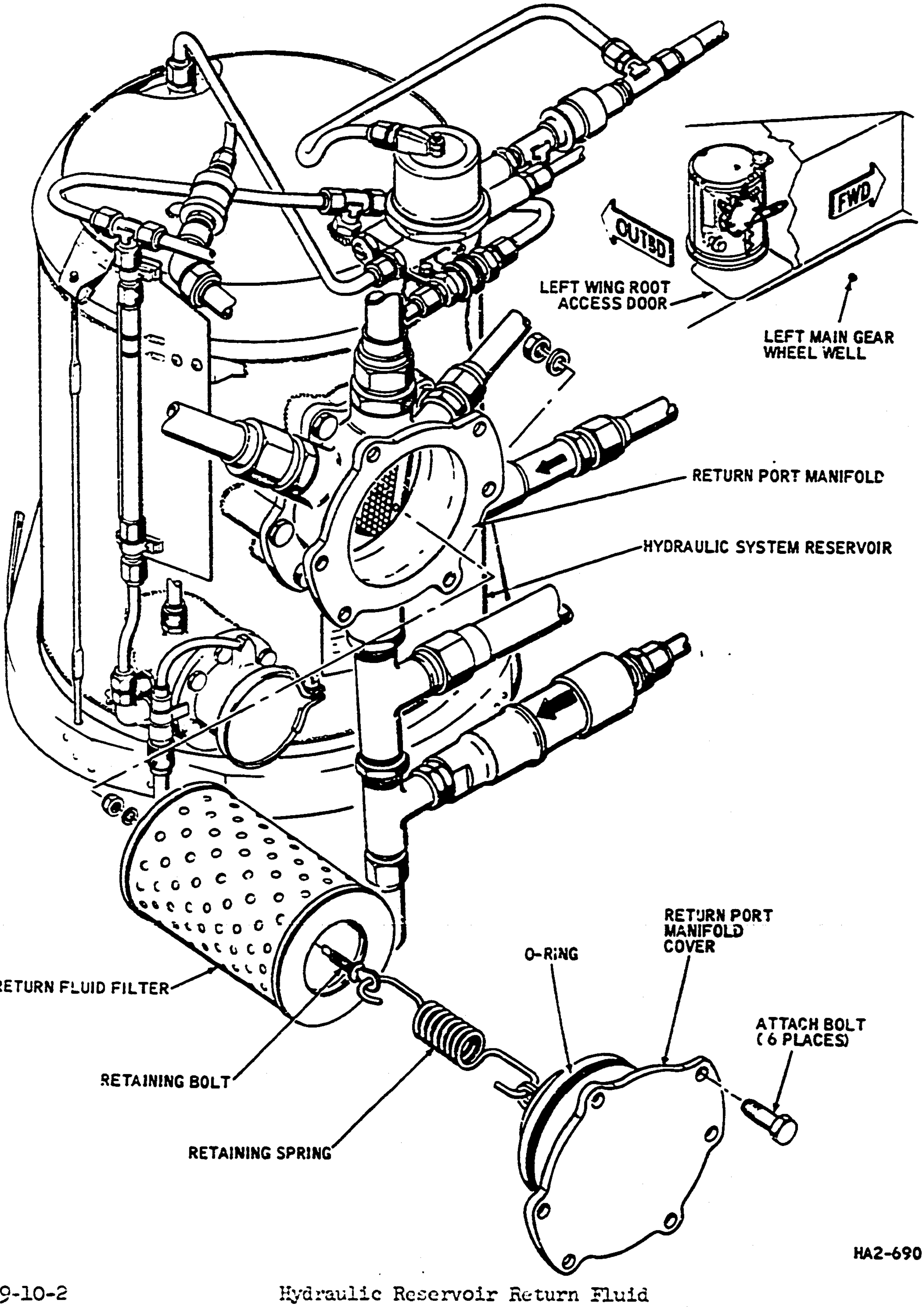
      (6) Remove nut from spring-tension eyebolt which protrudes through filter end plate.

      (7) Remove filter end plate and filter.

   B. Install Return Fluid Filter

      (1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

      (2) Check new filter for general condition and cleanliness.



Hydraulic Reservoir Return Fluid
Filter -- Installation
Figure 201

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(3) Place new filter in position against manifold cover.

(4) Insert threaded end of eyebolt through hole in end plate and install nut; tighten until nut bottoms on eyebolt threads.

(5) Install new O-ring on manifold cover, insert filter into reservoir, and align bolt holes.

(6) Apply antiseize compound to bolts and install bolts. Tighten to torque of 66 inch-pounds. Safety bolts with lockwire.

(7) Fill reservoir (see instruction placard on reservoir).

(8) Close auxiliary hydraulic pump control circuit breaker.

4. Inspection/Check Hydraulic Reservoir Return Fluid Filter

A. Check Return Fluid Filter

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check manifold cover bolts for security and lockwire.

(3) Check manifold cover for leaks.

HYDRAULIC RESERVOIR RETURN FLUID FILTER - MAINTENANCE PRACTICES

1. General

   A. The reservoir return fluid filter is located in the side of the hydraulic system reservoir, where it is mounted to the reservoir return port manifold cover.

   B. Access to the return fluid filter is through the left wing root access door and removal of the cover from the reservoir return port manifold.

2. Tools and Equipment Required

   A. Antiseize compound (Federal Specification TT-A-580, JAN-A-667) is used on bolts for installation of hydraulic reservoir return fluid filter.

3. Removal/Installation Hydraulic Reservoir Return Fluid Filter

   A. Remove Return Fluid Filter

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Remove bolts from return port manifold cover and remove cover from manifold.

      NOTE: Reservoir return fluid filter is attached to return ports manifold cover.

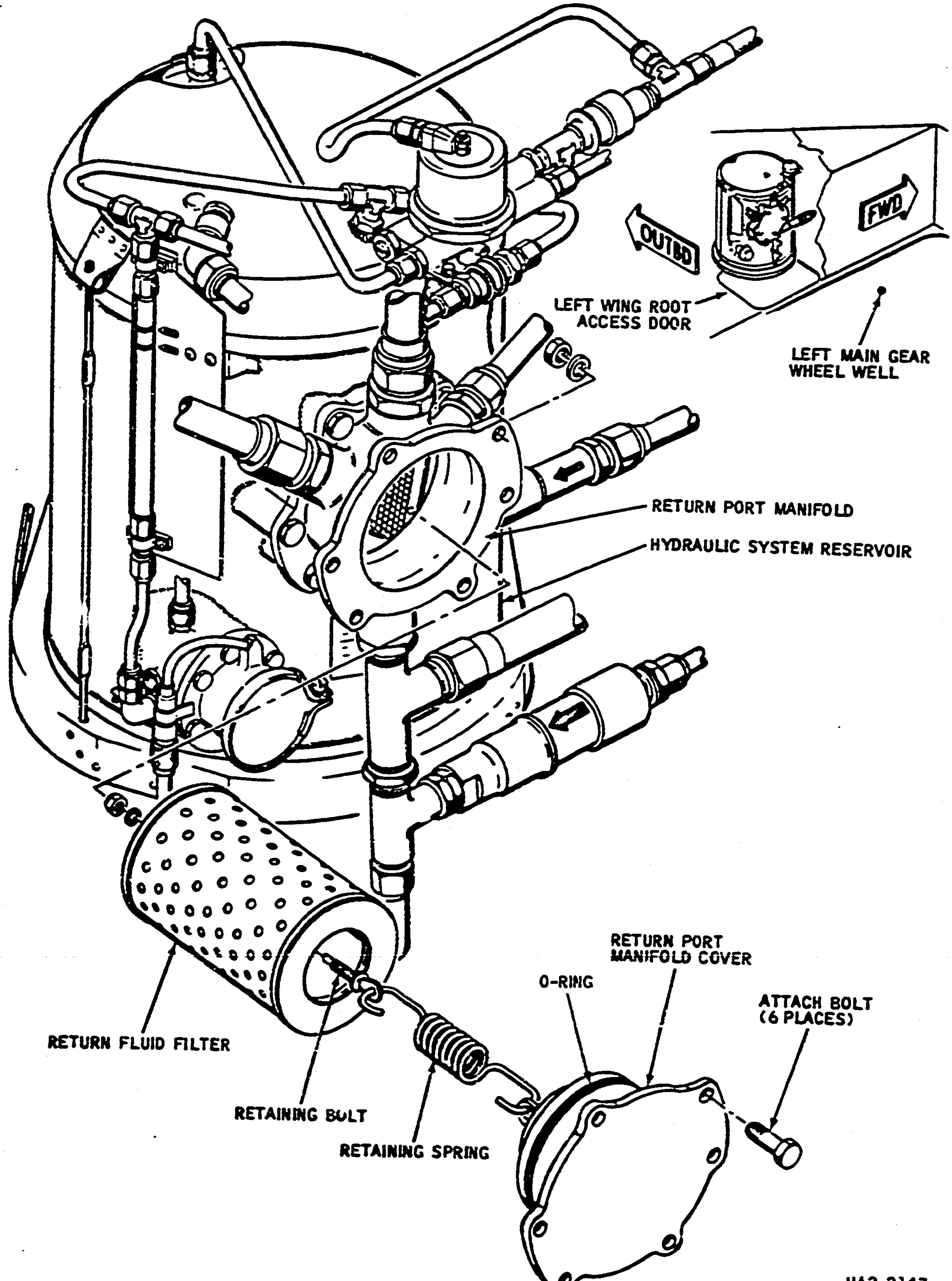
      (6) Remove nut from spring-tension eyebolt which protrudes through filter end plate.

      (7) Remove filter end plate and filter.

   B. Install Return Fluid Filter

      (1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

      (2) Check new filter for general condition and cleanliness.



Hydraulic Reservoir Return Fluid
Filter -- Installation
Figure 201

(3) Place new filter in position against manifold cover.

(4) Insert threaded end of eyebolt through hole in end plate and install nut; tighten until nut bottoms on eyebolt threads.

(5) Install new O-ring on manifold cover, insert filter into reservoir, and align bolt holes.

(6) Apply antiseize compound to bolts and install bolts. Tighten to torque of 66 inch-pounds. Safety bolts with lockwire.

(7) Fill reservoir (see instruction placard on reservoir).

(8) Close auxiliary hydraulic pump control circuit breaker.

4. Inspection/Check Hydraulic Reservoir Return Fluid Filter

A. Check Return Fluid Filter

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check manifold cover bolts for security and lockwire.

(3) Check manifold cover for leaks.

HYDRAULIC RESERVOIR RETURN FLUID FILTER - MAINTENANCE PRACTICES

1. General

   A. The reservoir return fluid filter is located in the side of the hydraulic system reservoir, under the return ports manifold.

   B. Access to the return fluid filter is through the left wing root access door.

2. Tools and Equipment Required

   A. Antiseize compound (Federal Specification TT-A-580, JAN-A-667) is used on bolts for installation of hydraulic reservoir return fluid filter.

3. Removal/Installation Hydraulic Reservoir Return Fluid Filter

   A. Remove Fluid Filter

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect lines from T-fitting at return port A.

      (6) Disconnect lines from T-fitting at wing flap return port.

      (7) Disconnect line from check valve at return port B.

      (8) Disconnect line from low-pressure return port.

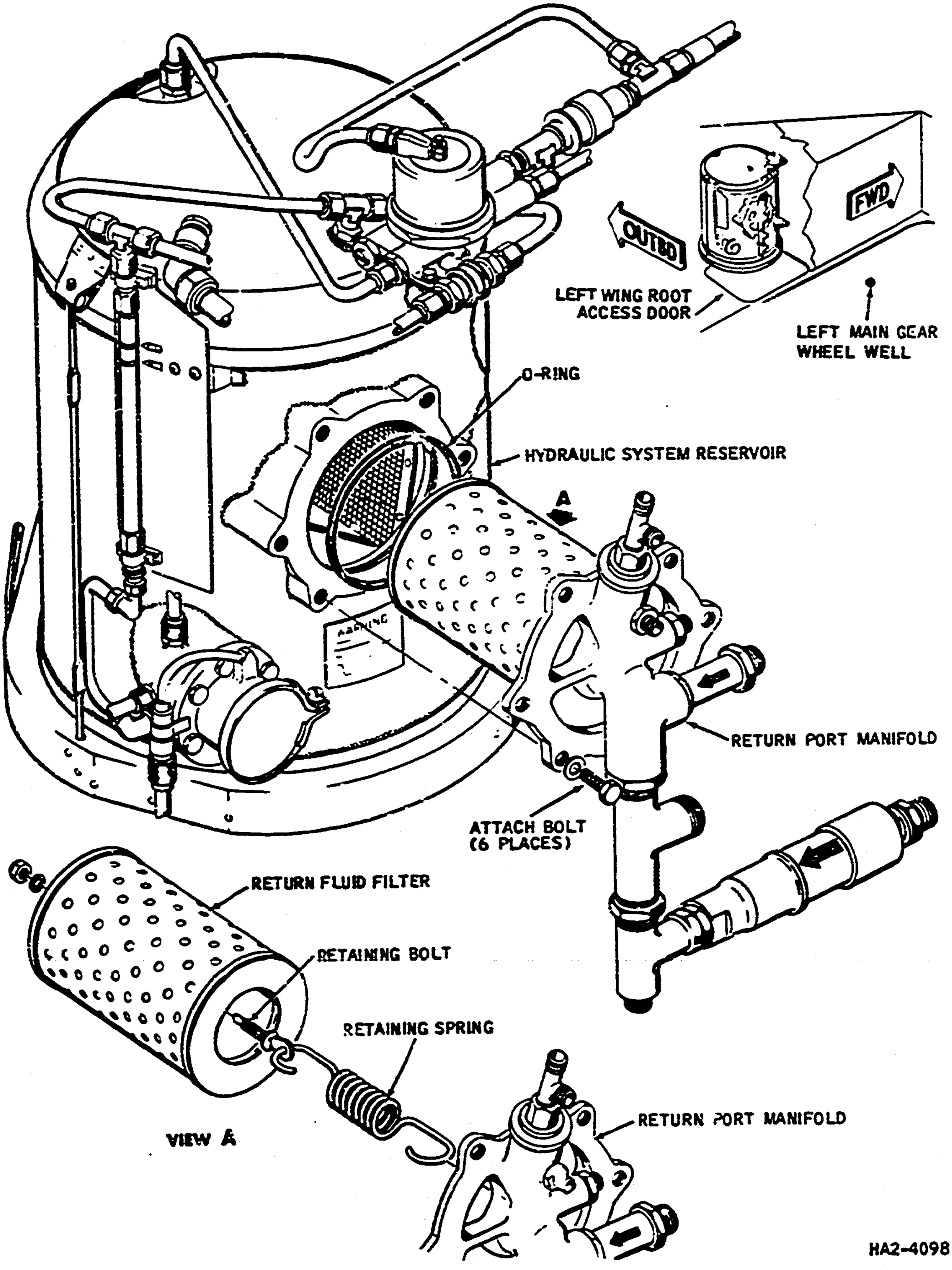
      (9) Disconnect line from bogie unlock return port.

      (10) Remove bolts from return port manifold and remove manifold.

      NOTE: Reservoir return fluid filter is attached to return ports manifold.

      (11) Remove nut from spring-tension eyebolt which protrudes through filter end plate.

      (12) Remove filter end plate and filter.



Hydraulic Reservoir Return Fluid
Filter -- Installation
Figure 201

B. Install Return Fluid Filter

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Check new filter for general condition and cleanliness.

(3) Place new filter in position against manifold.

(4) Insert threaded end of eyebolt through hole in end plate and install nut; tighten until nut bottoms on eyebolt threads.

(5) Install new O-ring on manifold, insert filter into reservoir, and align bolt holes.

(6) Apply antiseize compound to bolts and install bolts. Tighten to torque of 66 inch-pounds. Safety bolts with lockwire.

(7) Connect case drain line to low-pressure return port.

(8) Connect return line to check valve at return port B.

(9) Connect bypass line and wing flap return line to T-fitting at wing flap return port.

(10) Connect return lines to T-fitting at return port A.

(11) Connect bogie unlock return line to bogie return port.

(12) Fill reservoir (see instruction placard on reservoir).

(13) Close auxiliary hydraulic pump control circuit breaker.

4. Inspection/Check Hydraulic Reservoir Return Fluid Filter

A. Check Return Fluid Filter

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check hydraulic lines and fittings to all ports of return ports manifold for general condition, security of attachment, routing clearance, and leaks.

(3) Check return ports manifold flange gasket for leaks.

HYDRAULIC RESERVOIR RETURN FLUID FILTER - MAINTENANCE PRACTICES

1. General

A. The reservoir return fluid filter is located in the side of the hydraulic system reservoir, under the return ports manifold.

B. Access to the return fluid filter is through the left wing root access door.

2. Tools and Equipment Required

A. Antiseize compound (Federal Specification TT-A-580, JAN-A-667) is used on bolts for installation of hydraulic reservoir return fluid filter.

3. Removal/Installation Hydraulic Reservoir Return Fluid Filter

A. Remove Return Fluid Filter

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect lines from T-fitting at return port A.

(6) Disconnect lines from T-fitting at wing flap return port.

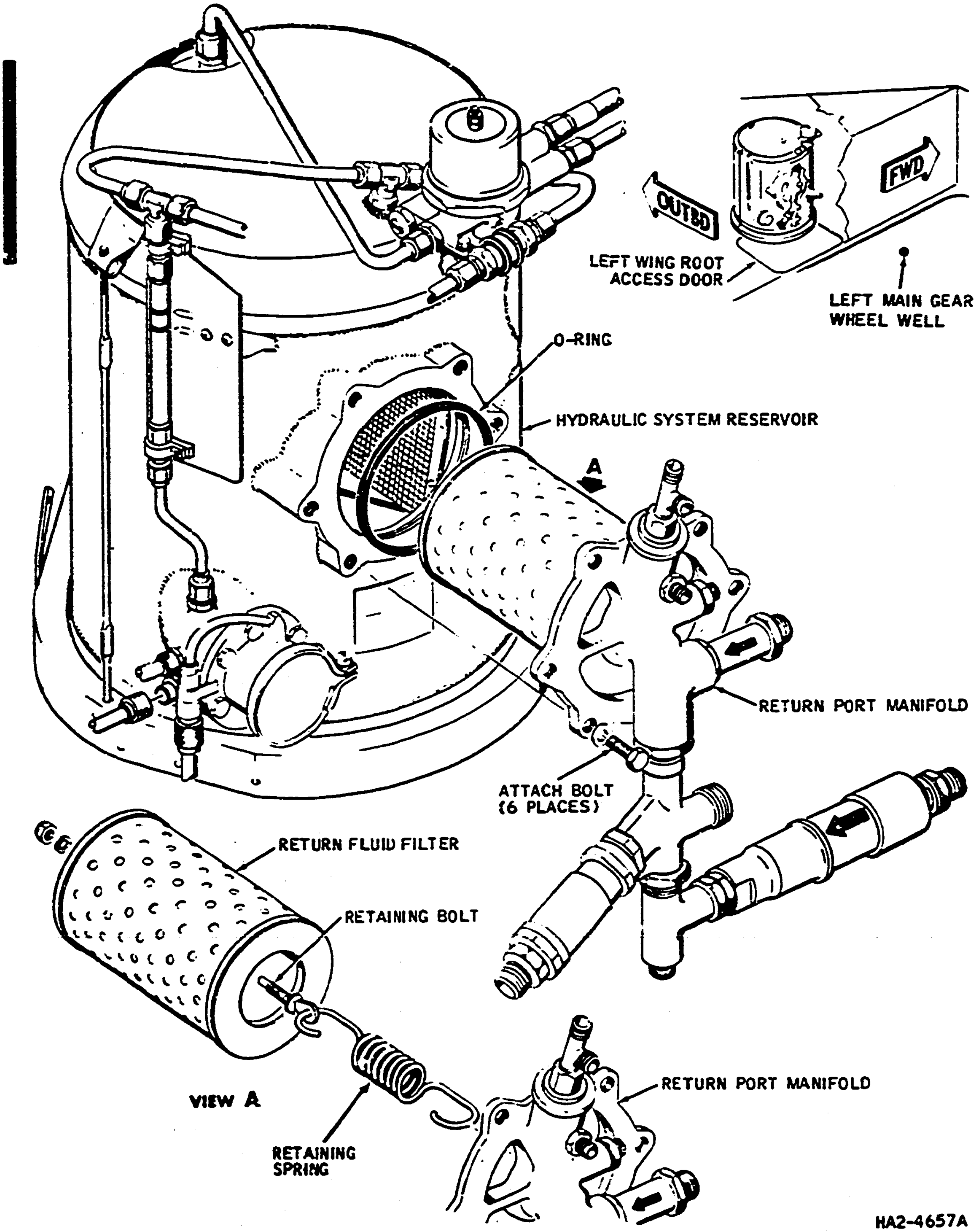
(7) Disconnect line from check valve at return port B.

(8) Disconnect line from low-pressure return port.

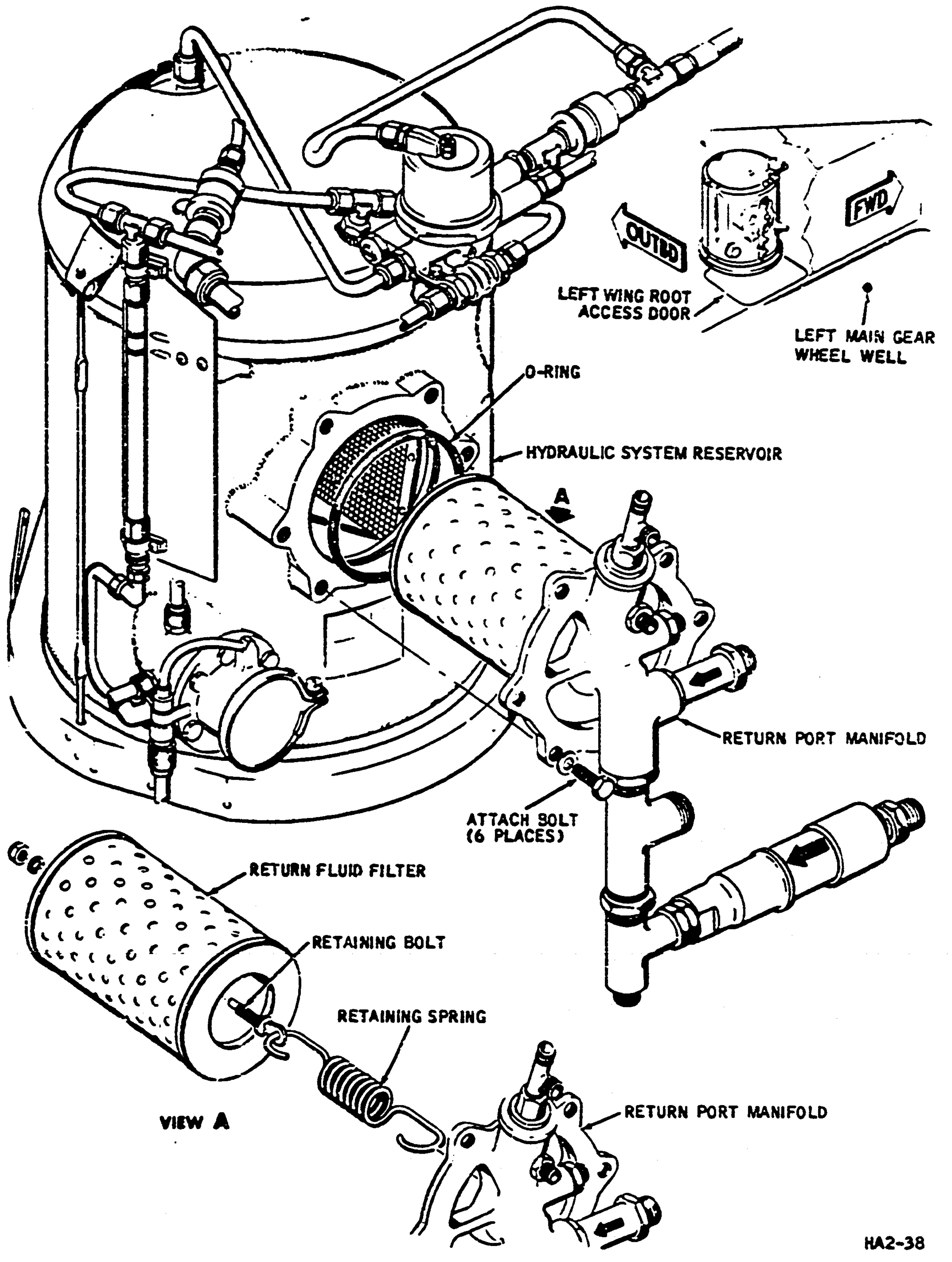
(9) Disconnect line from bogie unlock return port.

(10) Remove bolts from return port manifold and remove manifold.

NOTE: Reservoir return fluid filter is attached to return ports manifold.



Hydraulic Reservoir -- Return Port
(Airplanes 801-811)
Figure 201 (Sheet 1)



Hydraulic Reservoir Return Fluid Filter -- Installation
(Airplanes 812-822, 860-863)
Figure 201 (Sheet 2)

(11) Remove nut from spring-tension eyebolt which protrudes through filter end plate.

(12) Remove filter end plate and filter.

B. Install Return Fluid Filter

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Check new filter for general condition and cleanliness.

(3) Place new filter in position against manifold.

(4) Insert threaded end of eyebolt through hole in end plate and install nut; tighten until nut bottoms on eyebolt threads.

(5) Install new O-ring on manifold, insert filter into reservoir, and align bolt holes.

(6) Apply antiseize compound to bolts and install bolts. Tighten to torque of 66 inch-pounds. Safety bolts with lockwire.

(7) Connect case drain line to low-pressure return port.

(8) Connect return line to check valve at return port B.

(9) Connect bypass line and wing flap return line to T-fitting at wing flap return port.

(10) Connect return lines to T-fitting at return port A.

(11) Connect bogie unlock return line to bogie return port.

(12) Fill reservoir (see instruction placard on reservoir).

(13) Close auxiliary hydraulic pump control circuit breaker.

4. Inspection/Check Hydraulic Reservoir Return Fluid Filter

A. Check Return Fluid Filter

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check hydraulic lines and fittings to all ports of return ports manifold for general condition, security of attachment, routing clearance and leaks.

(3) Check return ports manifold flange gasket for leaks.

HYDRAULIC RESERVOIR AIR PRESSURE REGULATOR-ASPIRATOR - MAINTENANCE PRACTICES

1. General

   A. The regulator-aspirator is located on the top inboard side of the hydraulic system reservoir in the left wing root.

   B. Access to the regulator-aspirator is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Air Pressure Regulator-Aspirator

   A. Remove Air Pressure Regulator-Aspirator

      (1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (3) Disconnect low-pressure hydraulic line from outlet port of aspirator.

      (4) Disconnect hydraulic system pressure line from fluid inlet port of aspirator.

      (5) Disconnect cabin air supply hose.

      (6) Remove air diverter line.

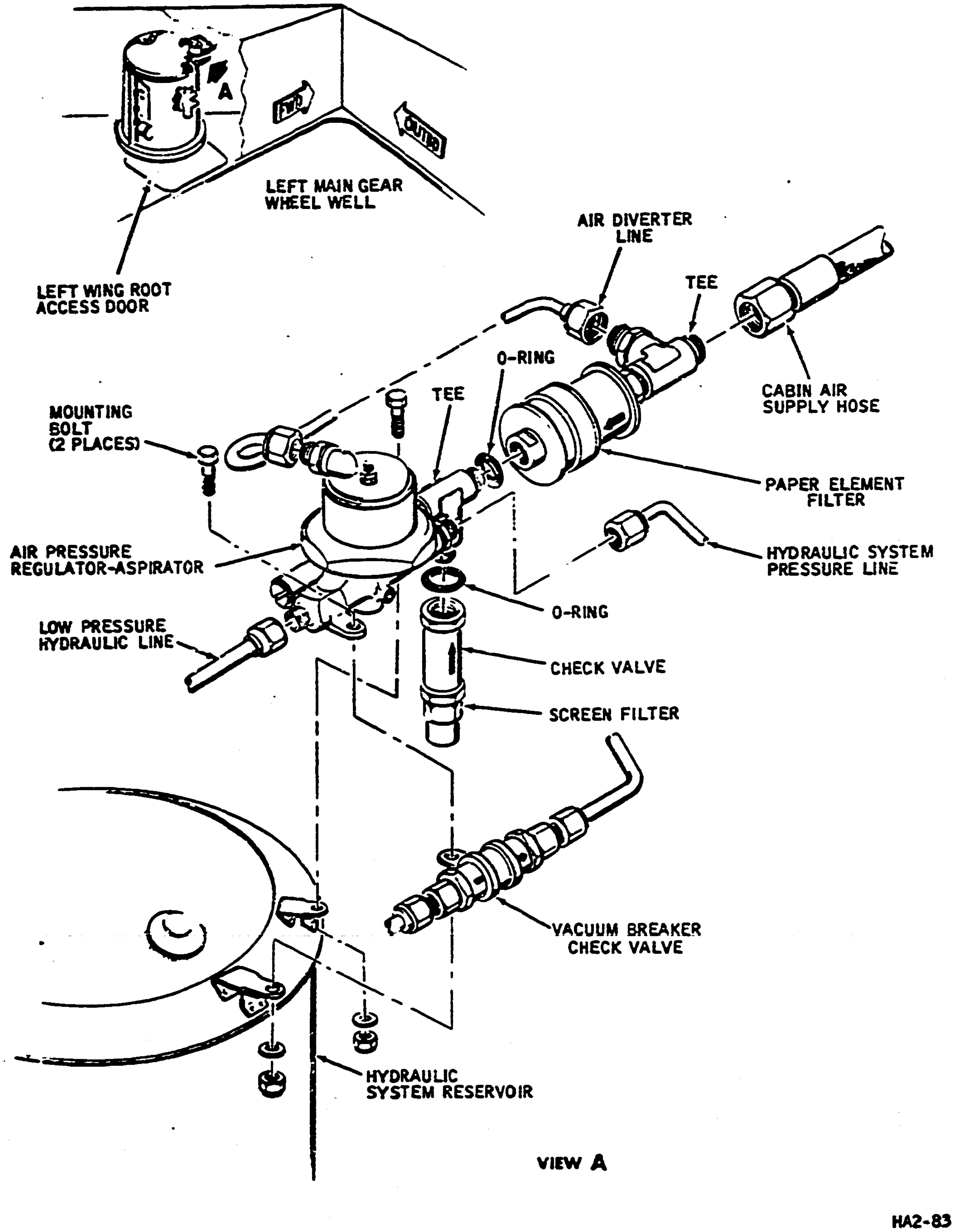
      (7) Remove T-fitting with screen filter, check valve, and paper element filter as an assembly from cabin air inlet port of aspirator.

      (8) Remove regulator-aspirator.

      (9) Remove fittings from air diverter line port, fluid inlet port, and air-fluid outlet port. Discard O-rings.

   B. Install Air Pressure Regulator-Aspirator

      (1) Using new O-rings, install fittings in air diverter line port, fluid inlet port, and air-fluid outlet port.



Reservoir Air Pressure Regulator-
Aspirator -- Installation
Figure 201

(2) Using new O-rings, install T-fitting with screen filter, check valve, and paper element filter, as an assembly in cabin air inlet port of aspirator.

CAUTION: MAKE CERTAIN THAT CABIN AIR FILTER OUTLET PORT IS DIRECTED TOWARD AIR INLET PORT OF ASPIRATOR BODY.

NOTE: If air inlet paper element filter is to be replaced, see 29-10-5.

(3) Install air diverter line.

(4) Install regulator-aspirator on hydraulic reservoir mounting brackets.

(5) Connect cabin air supply line hose to T-fitting upstream of paper element filter.

(6) Connect low-pressure hydraulic line to outlet port of aspirator.

(7) Connect hydraulic pressure system line to fluid inlet port of aspirator.

3. Inspection/Check Hydraulic Reservoir Air Pressure Regulator-Aspirator

A. Check Hydraulic Reservoir Air Pressure Regulator-Aspirator

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices). Monitor reservoir air pressure gage at reservoir air bleed valve for pressure rise in reservoir.

NOTE: The reservoir should pressurize to 30 to 35 psi in approximately 4 minutes.

(2) Check pressure lines and connections for fluid leaks.

NOTE: Slight hydraulic fluid leakage fro. the drain hole located in the T-fitting installed between the air hose and the aspirator filter is normal and acceptable at hydraulic reservoir pressures below 5 psi.

(3) Check air-fluid line and connections for leaks.

(4) Check regulator-aspirator for security of mounting and general condition.

HYDRAULIC RESERVOIR AIR PRESSURE REGULATOR-ASPIRATOR - MAINTENANCE PRACTICES

1. General

   A. The regulator-aspirator is located on the top inboard side of the hydraulic system reservoir in the left wing root.

   B. Access to the regulator-aspirator is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Air Pressure Regulator-Aspirator

   A. Remove Air Pressure Regulator-Aspirator

      (1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (3) Disconnect low-pressure hydraulic line from outlet port of aspirator.

      (4) Disconnect hydraulic system pressure line from fluid inlet port of aspirator.

      (5) Disconnect air inlet hose.

      (6) Remove air diverter line.

      (7) Remove regulator-aspirator.

      (8) Remove fittings from fluid inlet port, air inlet port, and air-fluid outlet port. Discard O-rings.

   B. Install Air Pressure Regulator-Aspirator

      (1) Using new O-rings, install fittings in air inlet port, fluid inlet port, and air-fluid outlet port.

      CAUTION: MAKE CERTAIN THAT CABIN AIR FILTER OUTLET PORT IS DIRECTED TOWARD AIR INLET PORT OF ASPIRATOR BODY.

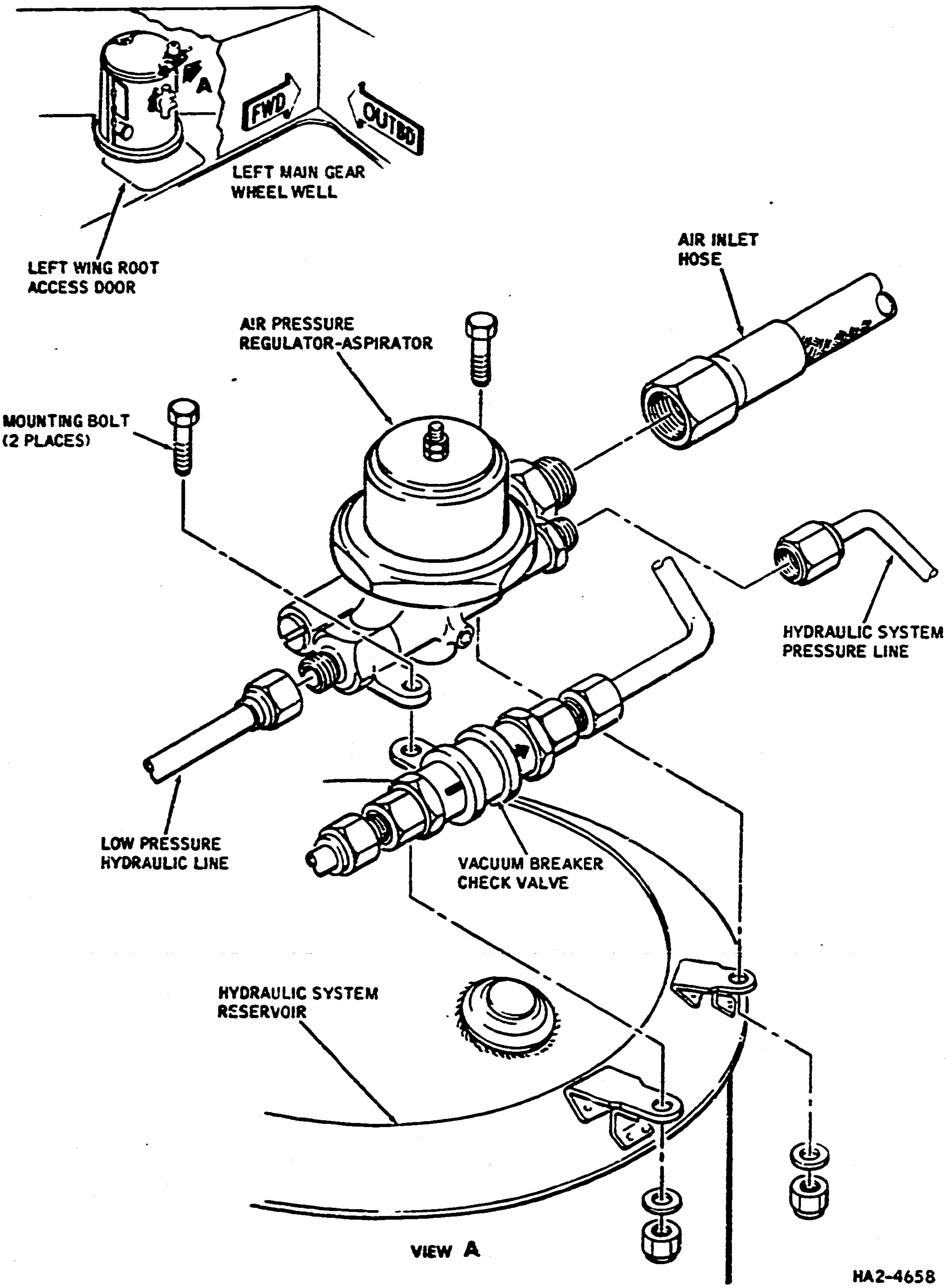
      NOTE: If air inlet paper element filter is to be replaced, see 29-10-5.

      (2) Install regulator-aspirator on hydraulic reservoir mounting brackets.

      (3) Connect air inlet hose to air inlet port of aspirator.

      (4) Connect low-pressure hydraulic line to outlet port of aspirator.

      (5) Connect hydraulic pressure system line to fluid inlet port of aspirator.



Reservoir Air Pressure Regulator-
Aspirator -- Installation
Figure 201

3. Inspection/Check Hydraulic Reservoir Air Pressure Regulator-Aspirator

A. Check Hydraulic Reservoir Air Pressure Regulator-Aspirator

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices). Monitor reservoir air pressure gage at reservoir air bleed valve for pressure rise in reservoir.

NOTE: The reservoir should pressurize to 35 to 40 psi in approximately 4 minutes.

(2) Check pressure lines and connections for fluid leaks.

(3) Check air-fluid line and connections for leaks.

(4) Check regulator-aspirator for security of mounting and general condition.

HYDRAULIC RESERVOIR AIR PRESSURE REGULATOR-ASPIRATOR - MAINTENANCE PRACTICES

1. General

   A. The regulator-aspirator is located on the top inboard side of the hydraulic system reservoir in the left wing root.

   B. Access to the regulator-aspirator is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Air Pressure Regulator-Aspirator

   A. Remove Air Pressure Regulator-Aspirator

      (1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (3) Disconnect low-pressure hydraulic line from outlet port of aspirator.

      (4) Disconnect hydraulic system pressure line from fluid inlet port of aspirator.

      (5) Disconnect hose from air inlet port T-fitting of regulator-aspirator.

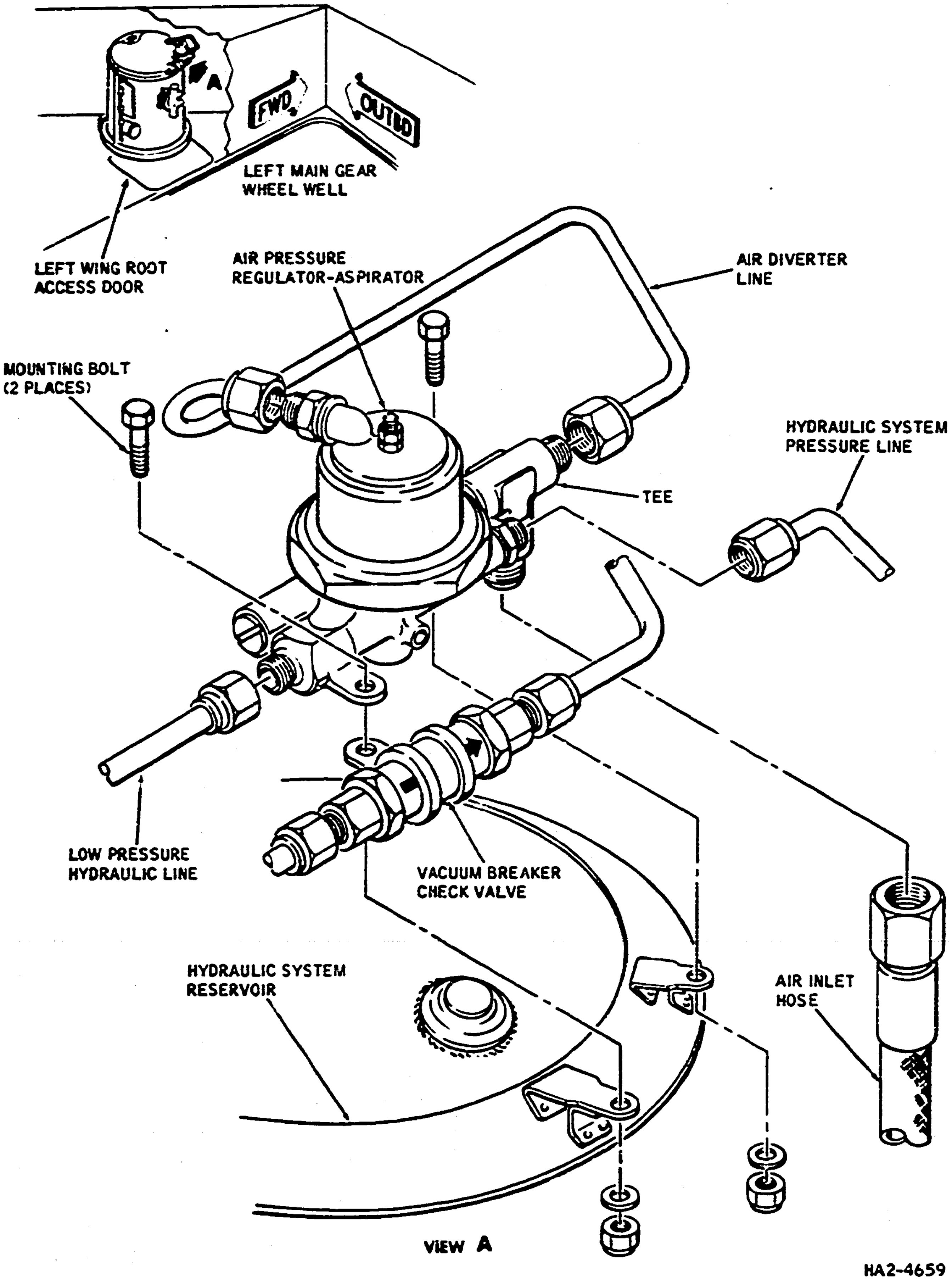
      (6) Remove air diverter line.

      (7) Remove regulator-aspirator.

      (8) Remove fittings from air diverter line ports, fluid inlet port, and air-fluid outlet port. Discard O-rings.

   B. Install Air Pressure Regulator-Aspirator

      (1) Using new O-rings, install fittings in air diverter line ports, fluid inlet port, and air-fluid outlet port.



Reservoir Air Pressure Regulator-
Aspirator Installation
Figure 201

(2) Install air diverter line.

(3) Install regulator-aspirator on hydraulic reservoir mounting brackets.

(4) Connect air supply hose to air inlet port T-fitting.

(5) Connect low-pressure hydraulic line to outlet port of aspirator.

(6) Connect hydraulic pressure system line to fluid inlet port of aspirator.

3. <u>Inspection/Check Hydraulic Reservoir Air Pressure Regulator-Aspirator</u>

A. Check Hydraulic Reservoir Air Pressure Regulator-Aspirator

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices). Monitor reservoir air pressure gage at reservoir air bleed valve for pressure rise in reservoir.

<u>NOTE</u>: The reservoir should pressurize to 35 to 40 psi in approximately 4 minutes.

(2) Check pressure lines and connections for fluid leaks.

(3) Check air-fluid line and connections for leaks.

(4) Check regulator-aspirator for security of mounting and general condition.

REGULATOR-ASPIRATOR AIR FILTERS - MAINTENANCE PRACTICES

1. General

   A. The regulator-aspirator air filters are located inboard and forward of the hydraulic system reservoir regulator-aspirator in the cabin air inlet line.

   B. Access to the filters is through the left wing root access door.

2. Removal/Installation Regulator-Aspirator Air Filters

   A. Remove Air Filters

      (1) Disconnect cabin air supply hose.

      (2) Remove line connected between T-fitting upstream of paper element filter, and regulator-aspirator.

      (3) Remove paper element filter from T-fitting installed in regulator-aspirator air inlet port. Discard O-ring.

      (4) Remove T-fitting from inlet port of paper element filter. Discard O-ring.

      (5) Remove screen filter from bottom of check valve installed at right angles to air inlet port of regulator-aspirator.

   B. Install Air Filters

      (1) Install screen filter in bottom of check valve at air inlet port of regulator-aspirator.

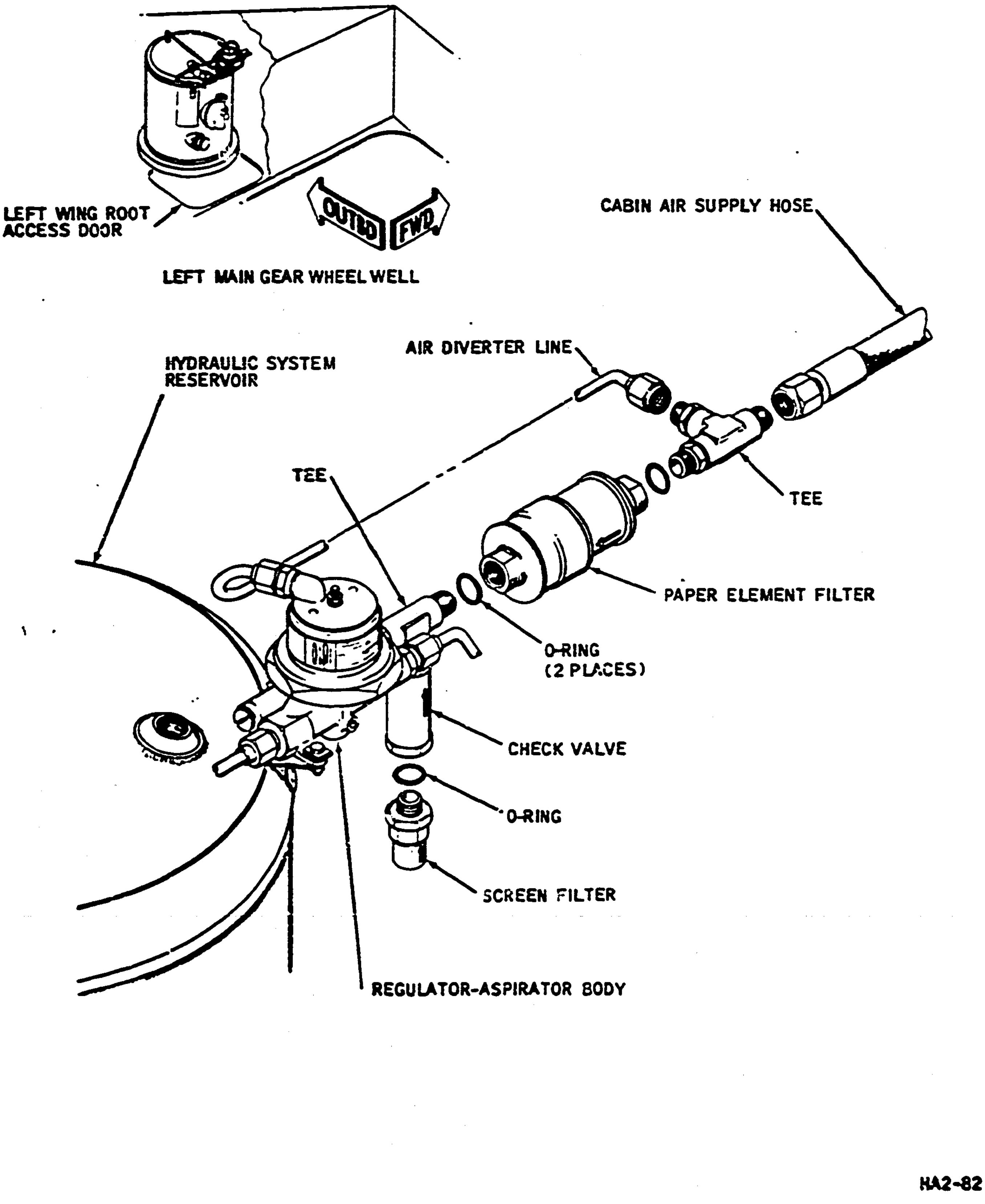
      (2) Using new O-ring, install T-fitting in inlet port of paper element filter.

      (3) Install paper element filter on T-fitting installed in regulator-aspirator air inlet port.

      CAUTION: MAKE CERTAIN THAT FILTER OUTLET PORT IS DIRECTED TOWARD ASPIRATOR BODY.

      (4) Install line between T-fitting upstream of paper element filter and regulator-aspirator.

      (5) Connect cabin air supply hose.



Regulator-Aspirator Air
Filters -- Installation
Figure 201

3. <u>Inspection/Check Regulator-Aspirator Air Filters</u>

A. Check Air Filters

(1) Visually check cabin air supply hose, filters, and connections for proper installation, general condition, and security of attachment.

<u>NOTE</u>: Make certain that paper element filter is properly installed with reservoir port directed toward the inlet port of the regulator-aspirator.

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REGULATOR-ASPIRATOR AIR FILTER ELEMENTS - MAINTENANCE PRACTICES

1. General

   A. The regulator-aspirator air filters are located inboard and forward of the hydraulic system reservoir regulator-aspirator in the cabin air inlet line.

   B. Access to the filters is through the left wing root access door.

2. Tools and Equipment Required

   A. Naphtha (Federal Specification P-D-680) is used for cleaning of the regulator-aspirator air filters.

3. Removal/Installation Regulator-Aspirator Air Filter Elements

   A. Remove Air Filter Elements

      (1) Disconnect cabin air supply hose.

      (2) Remove line connected between T-fitting upstream of paper element filter and regulator-aspirator.

      (3) Remove lockwire from paper element filter and remove head from filter case. Discard O-ring.

      (4) Remove paper filter element.

      (5) Remove screen filter from bottom of check valve installed at right angles to air inlet port of regulator-aspirator.

      (6) Remove screen from filter case.

      (7) Clean screen filter in naphtha (Federal Specification P-D-680); agitate and brush screen thoroughly to remove all dust, dirt, and foreign particles.

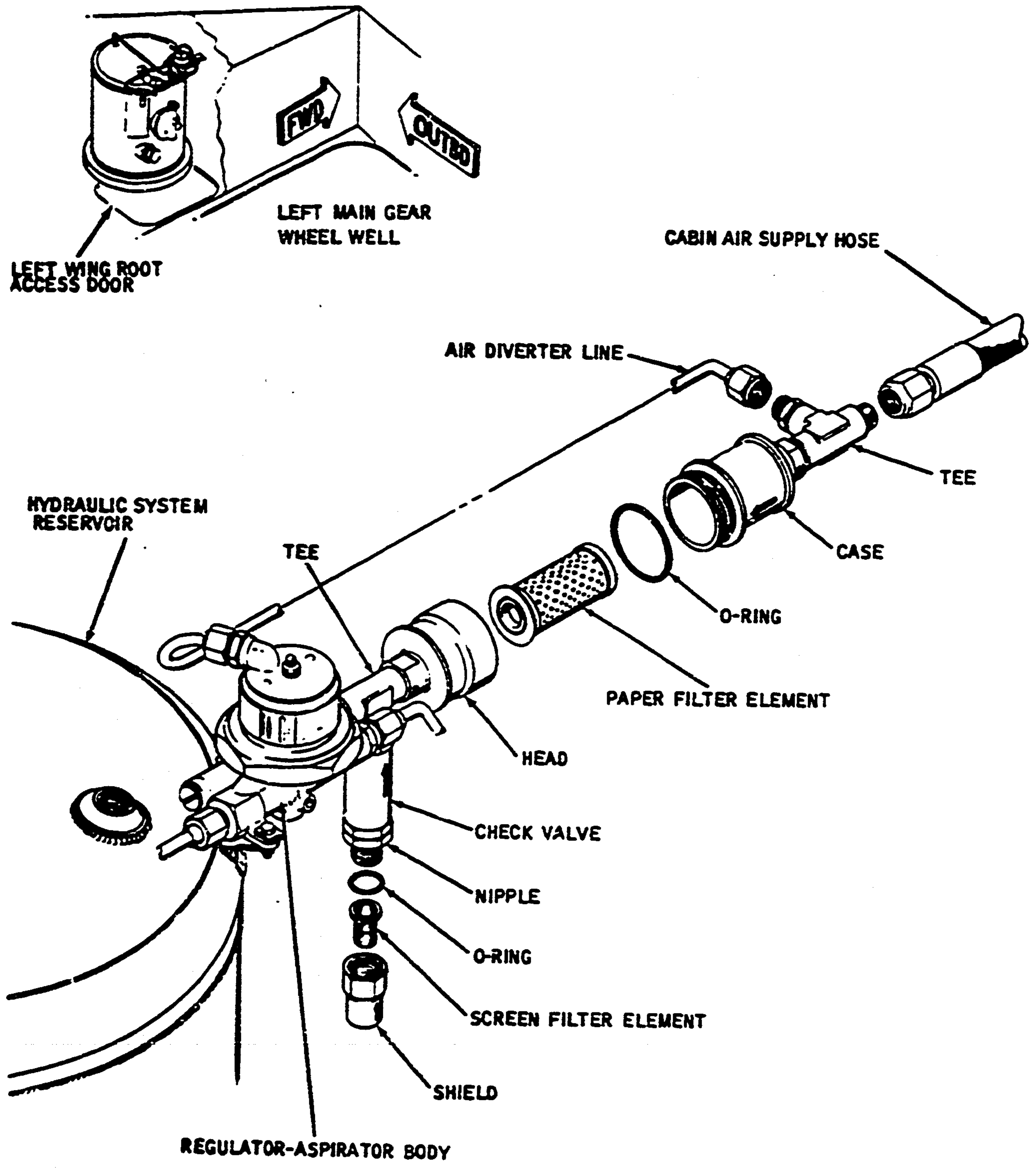
      (8) Air-dry screen with compressed air; direct air nozzle stream from inside of screen.

   B. Install Air Filter Elements

      (1) Install screen filter in screen filter case.

      (2) Install screen filter in bottom of check valve.

      (3) Insert a new paper filter element in paper element filter case.



Regulator-Aspirator Air Filter
Elements -- Installation
Figure 201

(4) Using new O-rings, install head of paper element filter on filter case. Safety head to case with lockwire.

(5) Install line between T-fitting upstream of paper element filter and regulator-aspirator.

4. Inspection/Check Regulator-Aspirator Air Filter Elements

A. Check Air Filter Elements

(1) Visually check cabin air supply hose, filters, and connections for proper installation, general condition, and security of attachment.

HYDRAULIC RESERVOIR RELIEF VALVE - MAINTENANCE PRACTICES

1. General

A. The reservoir relief valve is located in the overboard vent line downstream of the reservoir air bleed valve at the forward end of the left main gear wheel well.

B. Access to the reservoir relief valve is through the left main gear inboard door.

2. Removal/Installation Hydraulic Reservoir Relief Valve

A. Remove Relief Valve

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(3) Disconnect overboard vent line from outlet port of relief valve.

(4) Remove clamp and disconnect relief valve from cross fitting. Discard O-ring.

(5) Remove fitting from relief valve outlet; retain for use on new valve. Discard O-ring.

B. Install Relief Valve

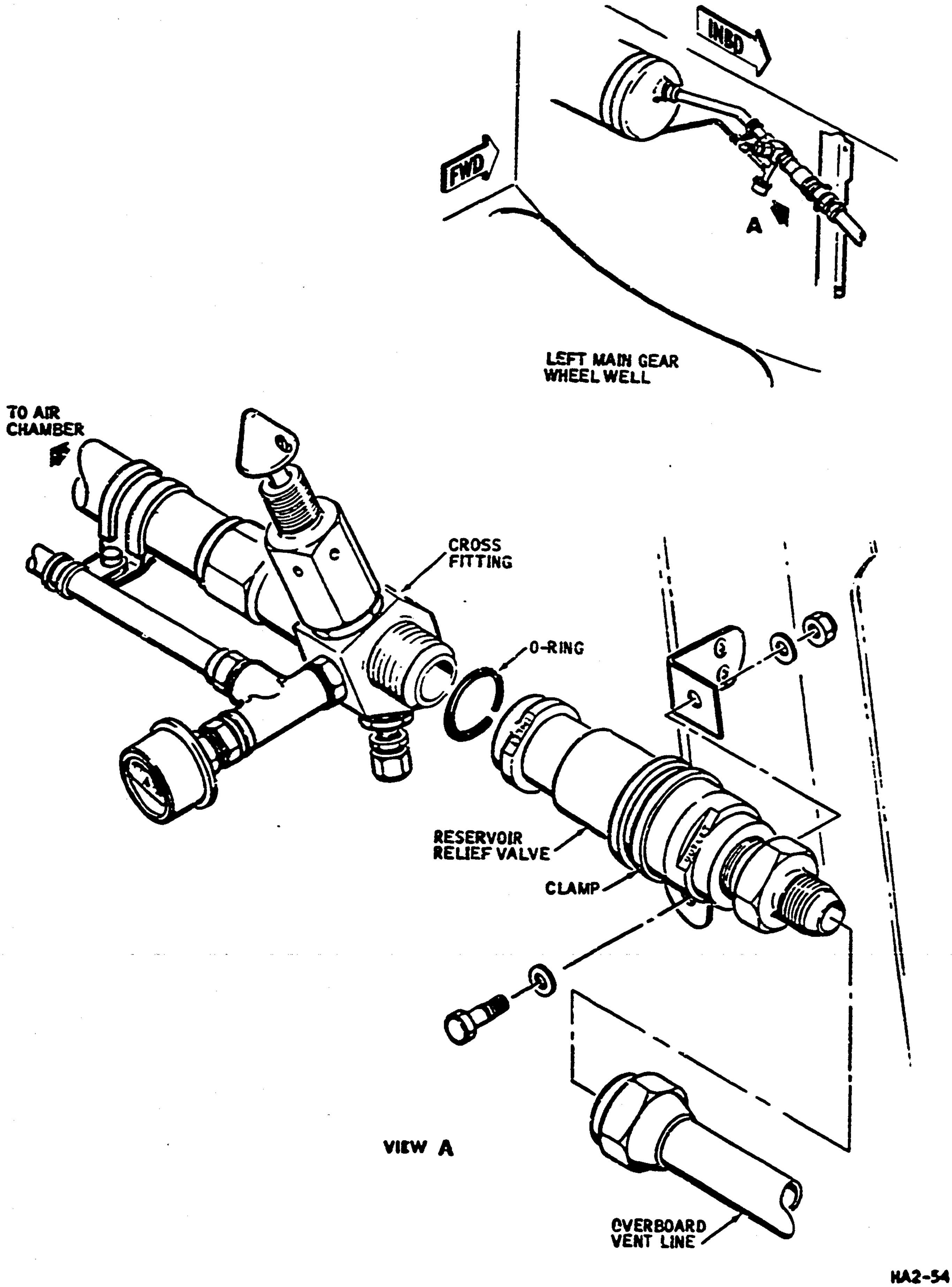
(1) Using new O-ring, install fitting in relief valve outlet.

(2) Using new O-ring, install relief valve on cross fitting.

(3) Install clamp on relief valve.

(4) Connect vent line to outlet port of relief valve.

(5) Pressurize hydraulic system reservoir (see 29-00, Maintenance Practices).



Reservoir Relief Valve -- Installation
Figure 201

3. Inspection/Check Hydraulic Reservoir Relief Valve

A. Check Relief Valve

(1) Check hydraulic reservoir relief valve for security of attachment, general condition, and air leaks.

HYDRAULIC RESERVOIR RELIEF VALVE - MAINTENANCE PRACTICES

1. General

A. The 45 psi reservoir relief valve is located in the overboard vent line downstream of the reservoir air bleed valve at the forward end of the left main gear wheel well.

B. The 60 psi reservoir relief valve is located on a special tee fitting in the A return port of the reservoir return ports manifold.

C. Access to the 45 psi reservoir relief valve is through the left main gear inboard door.

D. Access to the 60 psi reservoir relief valve is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Relief Valves

A. Remove 45 psi Relief Valve (See Figure 201.)

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(3) Disconnect overboard vent line from outlet port of relief valve.

(4) Remove clamp and disconnect relief valve from cross fitting. Discard O-ring.

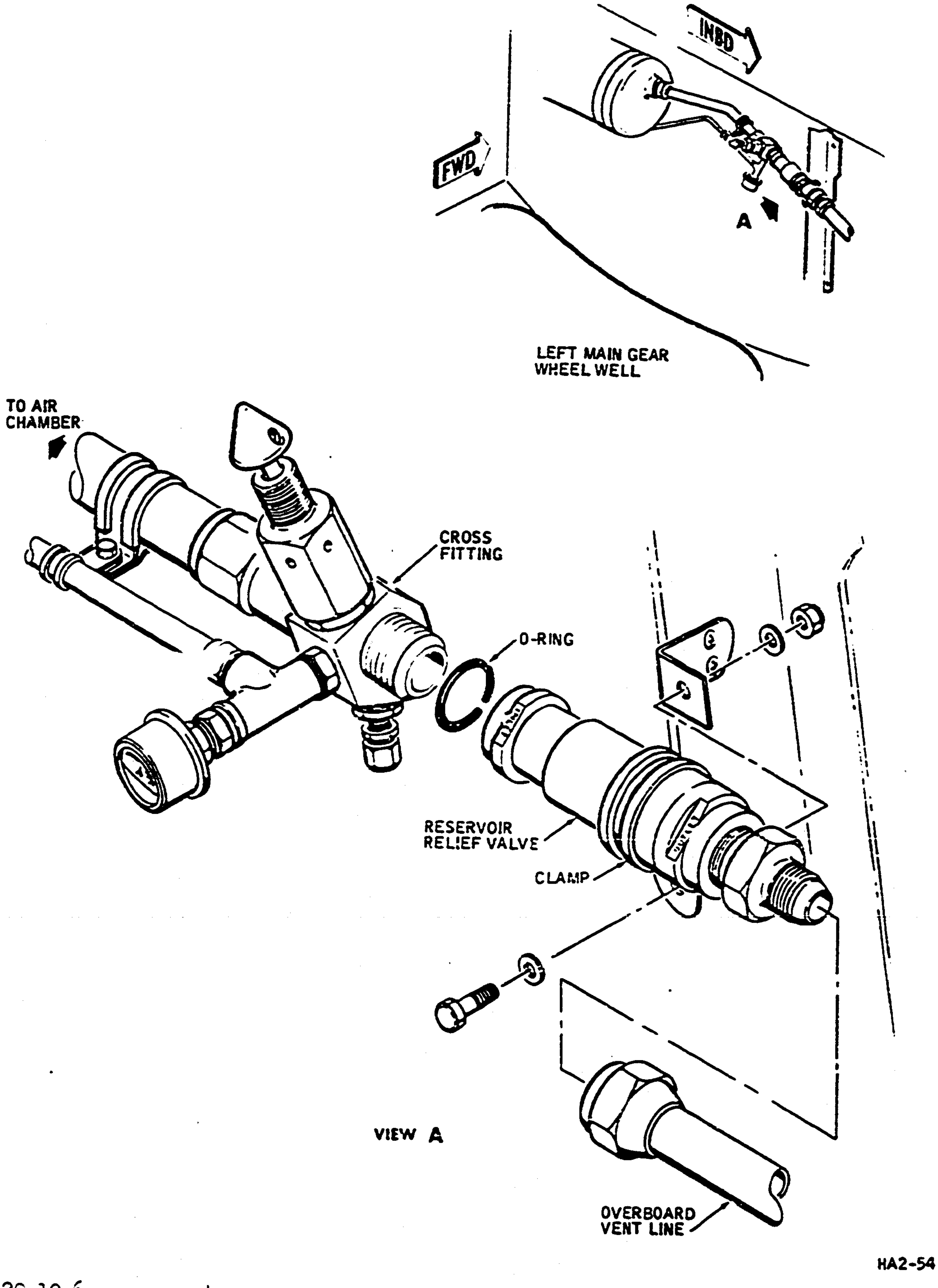
(5) Remove fitting from relief valve outlet; retain for use on new valve. Discard O-ring.

B. Install 45 psi Relief Valve (See Figure 201.)

(1) Using new O-ring, install fitting in relief valve outlet.

(2) Using new O-ring, install relief valve on cross fitting.

(3) Install clamp on relief valve.



45 PSI Reservoir Relief Valve -- Installation
Figure 201

(4) Connect vent line to outlet port of relief valve.

(5) Pressurize hydraulic system reservoir (see 29-00, Maintenance Practices).

C. Remove 60 PSI Relief Valve (See Figure 202.)

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(3) Drain hydraulic reservoir (see 29-00, Maintenance Practices).

(4) Disconnect drain line from outlet port of relief valve.

(5) Remove relief valve.

D. Install 60 PSI Relief Valve (See Figure 202.)

(1) Using new O-ring, install relief valve on reservoir return ports manifold fitting.

(2) Using new O-ring, install union in outlet end of relief valve.

(3) Connect drain line to outlet port of valve.

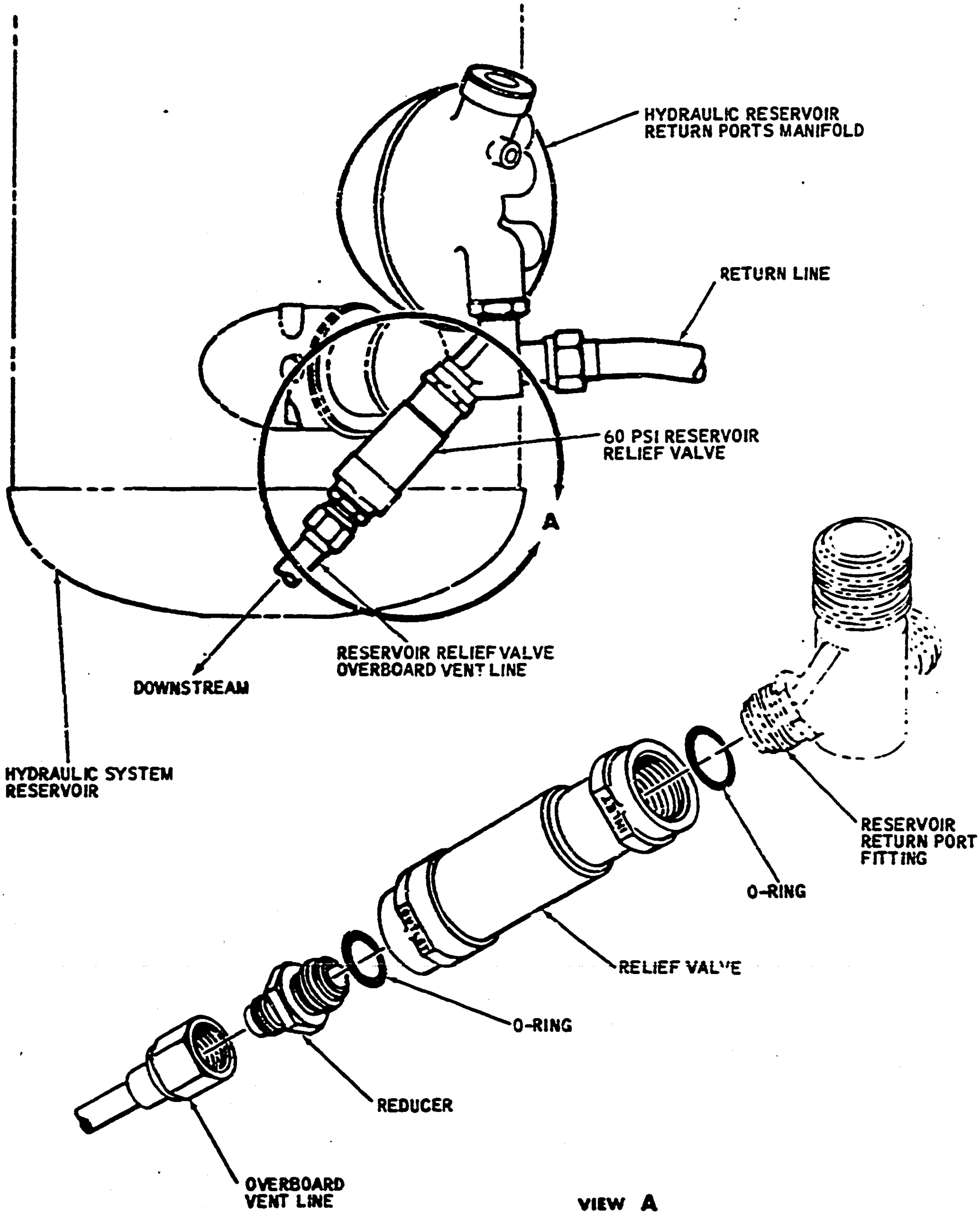
(4) Fill hydraulic reservoir (see 29-00 Maintenance Practices).

(5) Pressurize hydraulic system reservoir (see 29-00, Maintenance Practices).

3. <u>Inspection/Check Hydraulic Reservoir Relief Valves</u>

A. Check Relief Valve

(1) Check hydraulic reservoir relief valve for security of attachment, general condition, and air leaks.



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60 PSI Reservoir Relief Valve -- Installation
Figure 202

HYDRAULIC RESERVOIR AIR BLEED VALVE, AIR INFLATION VALVE, AND PRESSURE GAGE - MAINTENANCE PRACTICES

1. General

A. The reservoir air bleed valve, air inflation valve, and pressure gage are all mounted on a cross fitting located inboard of the reservoir air chamber, on the aft face of the rear spar in the left main gear wheel well.

B. Access to these components is through the left main gear inboard door.

2. Removal/Installation Hydraulic Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage

A. Remove Air Bleed Valve, Air Inflation Valve, and Pressure Gage

NOTE: Either of the valves or the pressure gage may be removed individually without disturbing the other components by performing steps (1) through (3), and then removing the desired components according to step (4), (5), or (6).

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

(3) Remove gage from T-fitting in cross fitting. Discard O-ring.

(4) Remove bleed valve from cross fitting. Discard O-ring.

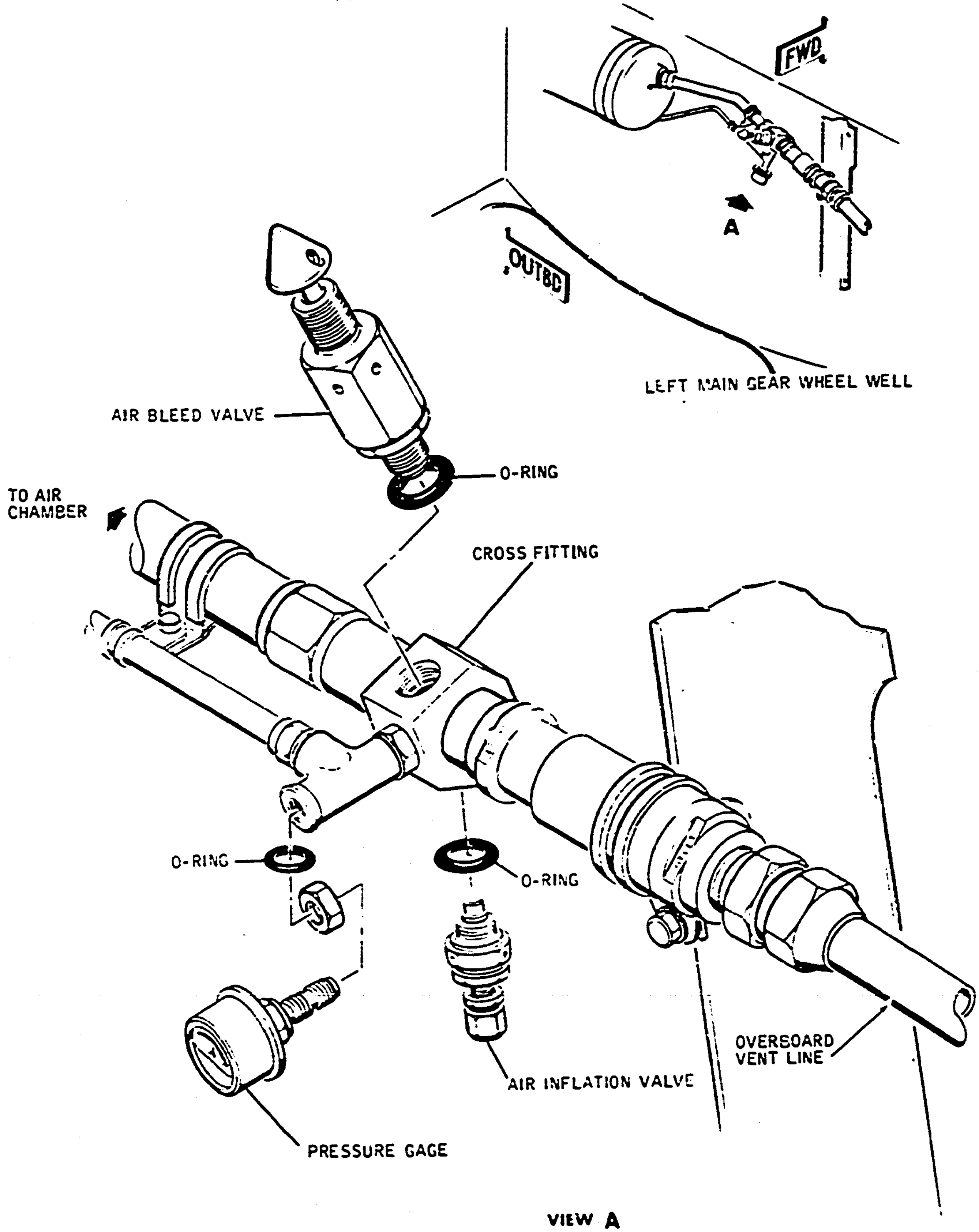
(5) Remove air inflation valve from cross fitting. Discard O-ring.

B. Install Air Bleed Valve, Air Inflation Valve, and Pressure Gage

(1) Using new O-ring, install air inflation valve in cross fitting.

(2) Using new O-ring, install bleed valve in cross fitting.

(3) Using new O-ring, install gage in tee on cross fitting.



Reservoir Air Bleed Valve, Air Inflation Valve,
and Pressure Gage -- Installation
Figure 201

3. Inspection/Check Hydraulic Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage

A. Check Air Bleed Valve, Air Inflation Valve, and Pressure Gage

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Check pressure gage for 30- to 35-psi reading.

(3) Check air bleed valve, air inflation valve, and pressure gage for air leaks.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Depress reservoir air bleed valve button. As air pressure drains off, check gage for zero indication.

NOTE: The clearance between the air bleed valve knob and the aileron cable pressure seal housing should be at least 5/8 inch.

HYDRAULIC RESERVOIR AIR BLEED VALVE, AIR INFLATION VALVE, AND PRESSURE GAGE - MAINTENANCE PRACTICES

1. General

   A. The reservoir air bleed valve, air inflation valve, and pressure gage are all mounted on a cross fitting located inboard of the reservoir air chamber, on the aft face of the rear spar in the left main gear wheel well.

   B. Access to these components is through the left main gear inboard door.

2. Removal/Installation Hydraulic Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage

   A. Remove Air Bleed Valve, Air Inflation Valve, and Pressure Gage

      NOTE: Either of the valves or the pressure gage may be removed individually without disturbing the other components by performing steps (1) through (3), and then removing the desired components according to step (4), (5), or (6).

      (1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (2) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (3) Remove gage from T-fitting in cross fitting. Discard O-ring.

      (4) Remove bleed valve from cross fitting. Discard O-ring.

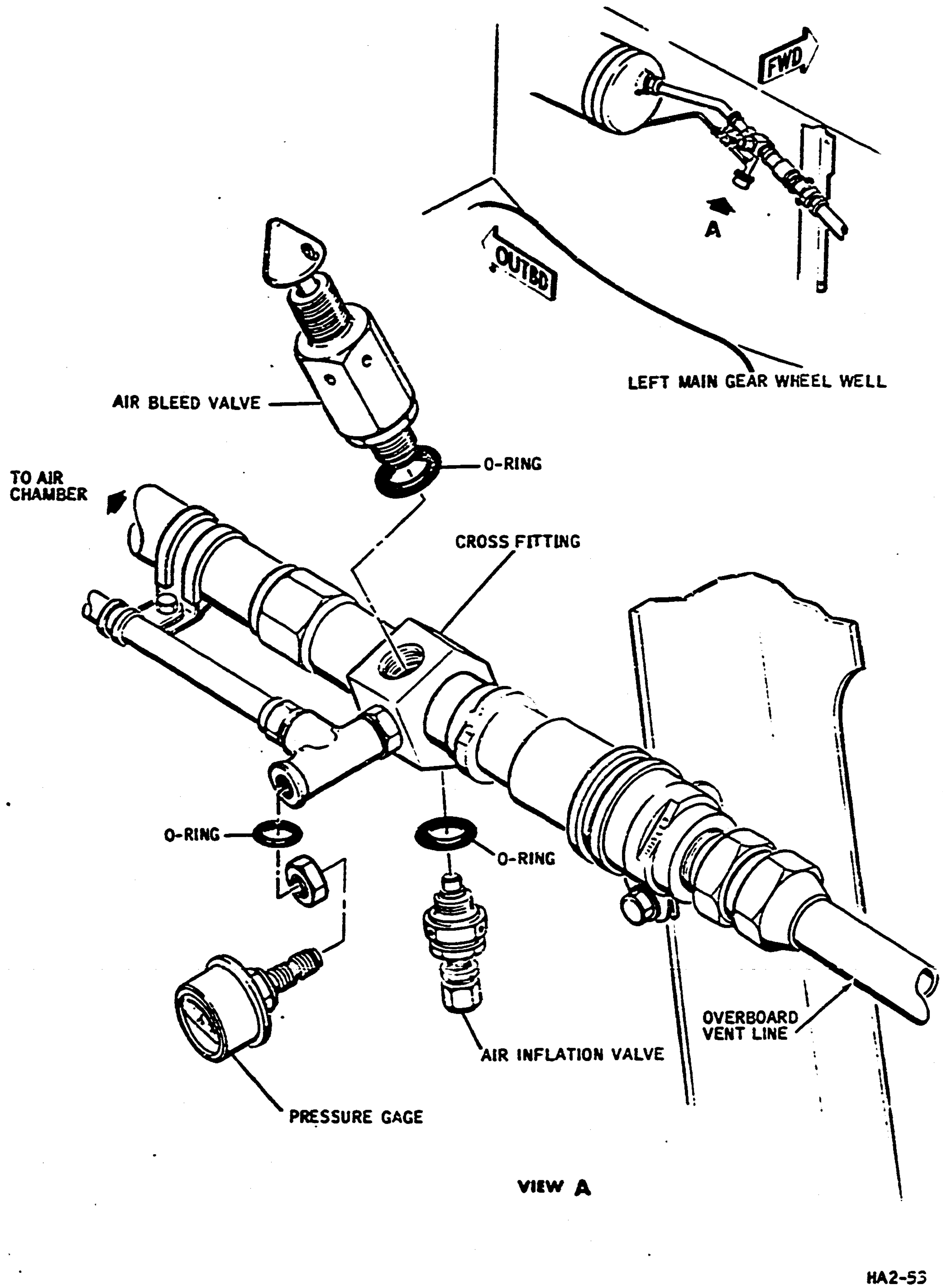
      (5) Remove air inflation valve from cross fitting. Discard O-ring.

   B. Install Air Bleed Valve, Air Inflation Valve, and Pressure Gage

      (1) Using new O-ring, install air inflation valve in cross fitting.

      (2) Using new O-ring, install bleed valve in cross fitting.

      (3) Using new O-ring, install gage in tee on cross fitting.



Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage -- Installation
Figure 201

3. Inspection/Check Hydraulic Reservoir Air Bleed Valve, Air Inflation Valve, and Pressure Gage

A. Check Air Bleed Valve, Air Inflation Valve, and Pressure Gage

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Check pressure gage for 35 to 40 psi on airplanes 801-815 or 30 to 35 psi on airplanes 816-822 and 860 and subsequent.

(3) Check air bleed valve, air inflation valve, and pressure gage for air leaks.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Depress reservoir air bleed valve button. As air pressure drains off, check gage for zero indication.

NOTE: The clearance between the air bleed valve knob and the aileron cable pressure seal housing should be at least 5/8 inch.

HYDRAULIC RESERVOIR VACUUM BREAKER CHECK VALVE - MAINTENANCE PRACTICES

1. General

A. The vacuum breaker check valve is located on the top side of the hydraulic system reservoir.

B. Access to the vacuum breaker check valve is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Breaker Check Valve

A. Remove Vacuum Breaker Check Valve

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(3) Disconnect ambient air vent line from inlet port of vacuum breaker check valve; retain short section of line.

(4) Disconnect line between vacuum breaker and reservoir vent port T-fitting.

(5) Loosen mounting clamp and remove vacuum breaker check valve.

B. Install Vacuum Breaker Check Valve

(1) Install vacuum breaker check valve in mounting clamp and tighten clamp.

(2) Connect reservoir vent port line to vacuum breaker.

(3) Connect ambient air vent line to vacuum breaker.

CAUTION: MAKE CERTAIN THAT THE VACUUM BREAKER CHECK VALVE IS INSTALLED WITH THE ARROW POINTING TOWARD THE RESERVOIR VENT PORT LINE.

(4) Pressurize hydraulic reservoir (see 29-00).

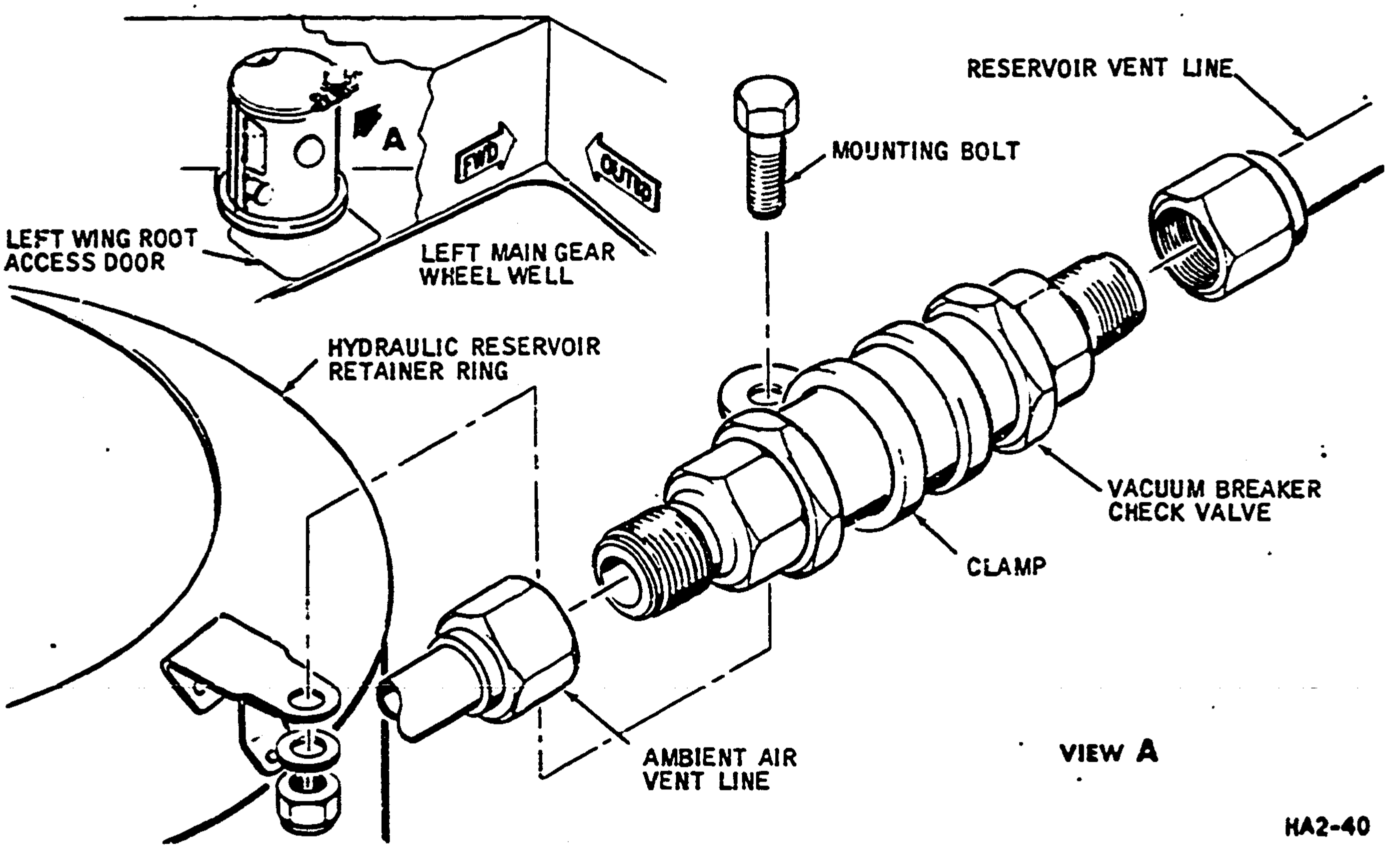
3. Inspection/Check Hydraulic Reservoir Vacuum Breaker Check Valve

A. Check Vacuum Breaker Check Valve

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Check vacuum breaker check valve for air leaks at line connection from reservoir and at open end of ambient vent line.

(3) Check valve for proper installation and general condition.



Hydraulic Reservoir Vacuum Breaker Check
Valve -- Installation
Figure 201

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HYDRAULIC RESERVOIR AIR CHAMBER - MAINTENANCE PRACTICES

1. General

A. The hydraulic reservoir air chamber is located in the forward area of the left main gear wheel well just outboard of the reservoir air bleed valve and air inflation valve.

B. Access to the hydraulic reservoir air chamber is through the left main gear inboard door.

2. Removal/Installation Hydraulic Reservoir Air Chamber

A. Remove Air Chamber

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(3) Disconnect lines from inlet and outlet ports of air chamber.

(4) Open clamps securing air chamber to support brackets and remove air chamber.

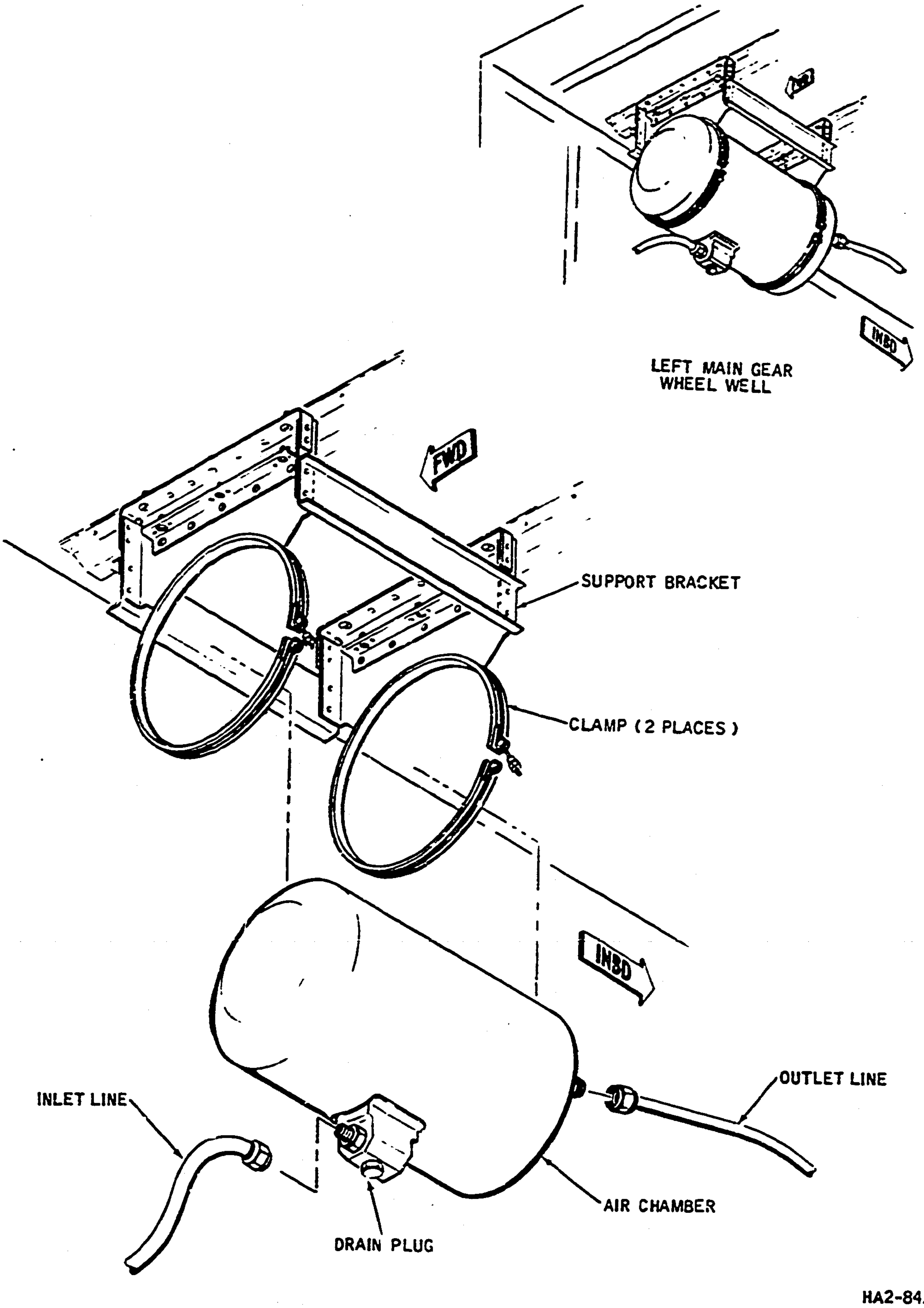
(5) Remove fittings from both ports and retain for use in new unit. Discard O-rings.

B. Install Air Chamber

(1) Using new O-rings, install fittings in inlet and outlet ports of air chamber.

(2) Install air chamber and connect clamps to secure chamber to support brackets.

(3) Connect lines to inlet and outlet ports of air chamber.



Hydraulic Reservoir Air Chamber -- Installation
Figure 201

3. Inspection/Check Hydraulic Reservoir Air Chamber

A. Check Air Chamber

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Check air chamber, lines and fittings for general condition, security of attachment, clearance, and leaks.

HYDRAULIC RESERVOIR RETURN PORT B CHECK VALVE - MAINTENANCE PRACTICES

1. General

   A. The hydraulic reservoir return port B check valve is installed in return port B of the hydraulic system reservoir return ports manifold.

   B. Access to return port B check valve is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Return Port B Check Valve

   A. Remove Return Port B Check Valve

      (1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (2) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (3) Relieve brake accumulator pressure by applying brakes 6 times minimum.

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect line from return port B check valve.

      (6) Remove check valve from port B.

   B. Install Return Port B Check Valve

      (1) Using new O-ring, install check valve in return port B.

      CAUTION: FLOW ARROW ON CHECK VALVE MUST POINT TOWARD RESERVOIR.

      (2) Connect line to check valve.

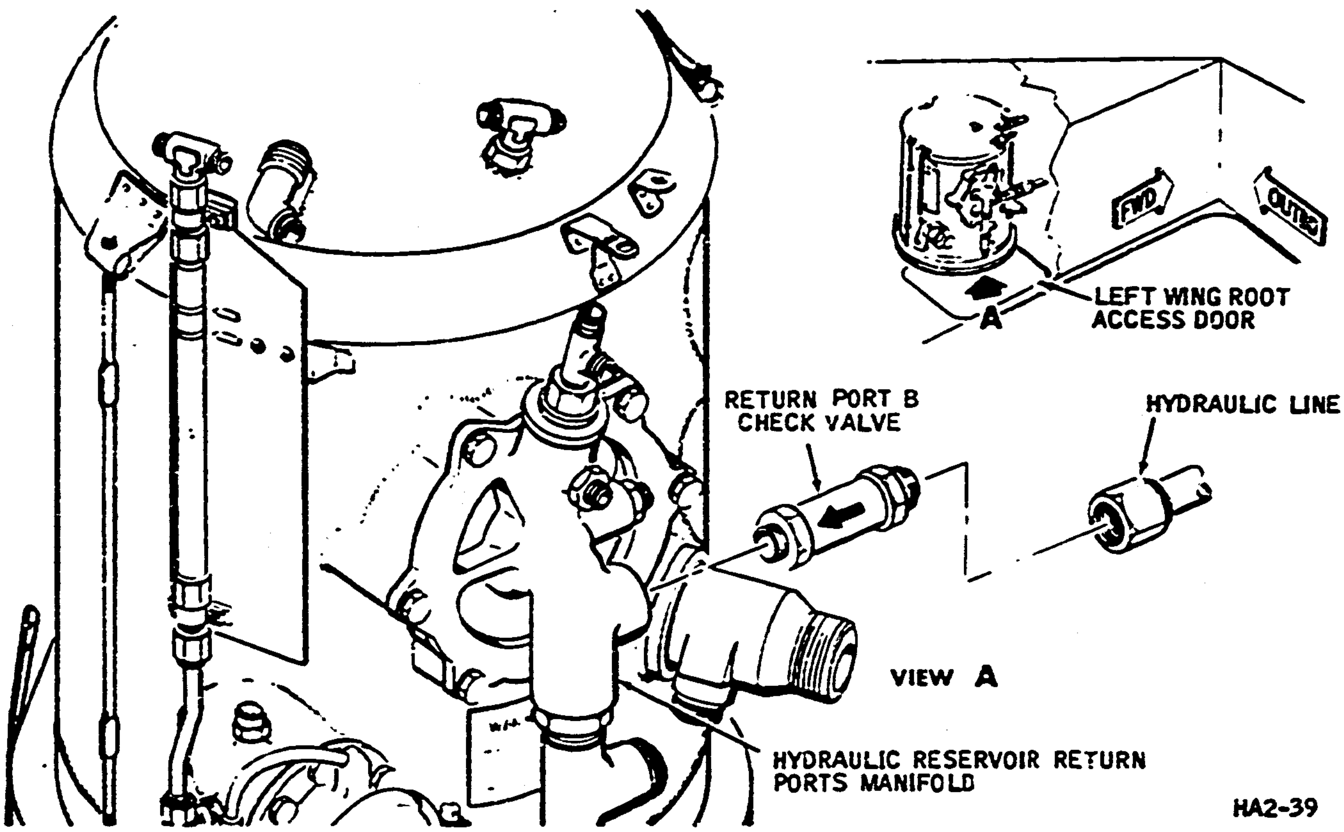
      (3) Fill hydraulic system reservoir (see instruction placard on reservoir).

      (4) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

3. Inspection/Check Hydraulic Reservoir Return Port B Check Valve

A. Check Return Port B Check Valve

(1) Check return port B check valve for proper installation and fluid leaks.



Hydraulic Reservoir Return Port B
Check Valve -- Installation
Figure 201

HYDRAULIC RESERVOIR RETURN PORT B CHECK VALVE - MAINTENANCE PRACTICES

1. General

   A. The hydraulic reservoir return port B check valve is installed in return port B of the hydraulic system reservoir return ports manifold.

   B. Access to return port B check valve is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Return Port B Check Valve

   A. Remove Return Port B Check Valve

      (1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (2) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (3) Relieve brake accumulator pressure by applying brakes 6 times minimum.

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect line from return port B check valve.

      (6) Remove check valve from port B.

   B. Install Return Port B Check Valve

      (1) Using new O-ring, install check valve in return port B.

      CAUTION: FLOW ARROW ON CHECK VALVE MUST POINT TOWARD RESERVOIR.

      (2) Connect line to check valve.

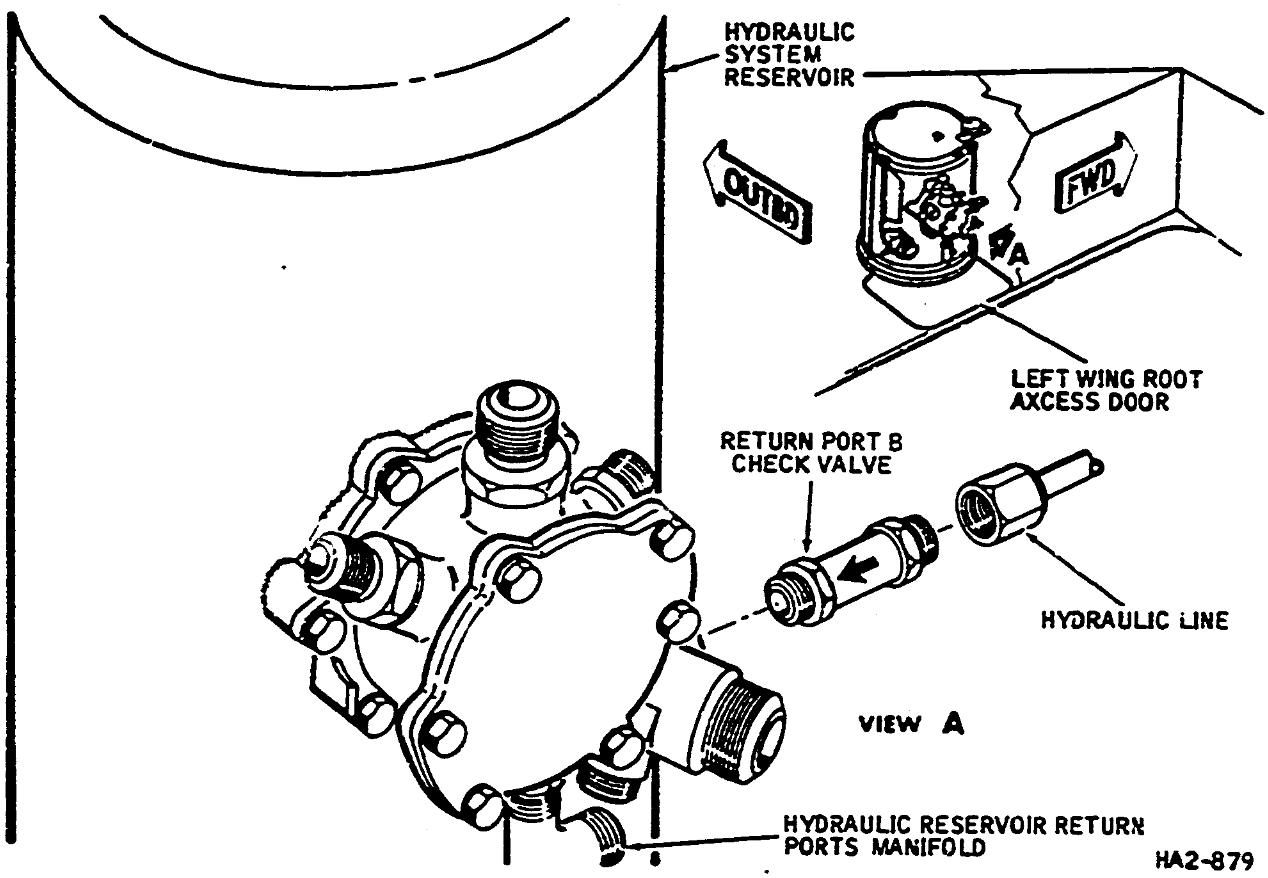
      (3) Fill hydraulic system reservoir (see instruction placard on reservoir).

      (4) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

3. Inspection/Check Hydraulic Reservoir Return Port B Check Valve

A. Check Return Port B Check Valve

(1) Check return port B check valve for proper installation and fluid leaks.



Hydraulic Reservoir Return Port B
Check Valve -- Installation
Figure 201

ENGINE HYDRAULIC FIRE SHUTOFF VALVE - MAINTENANCE PRACTICES

1. General

A. The two engine hydraulic fire shutoff valves are located in the wing leading edge, one valve aft of the firewall of each inboard pylon.

B. Access to the valves is through access doors located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. The valves are located inboard of the access door.

C. The removal/installation and inspection/check procedures for the left or right fire shutoff valves are identical. Maintenance practices concerning the fire shutoff valve cable system are covered in Chapter 76.

2. Removal/Installation Engine Hydraulic Fire Shutoff Valves

A. Remove Fire Shutoff Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

(4) Loosen turnbuckles, located in wing leading edge inboard of inboard pylons (see Chapter 76).

(5) Remove nut and washer attaching cable drum to locking hub on hydraulic fire shutoff valve and remove cable drum from hub.

(6) Disconnect hydraulic lines from inlet and outlet ports of valve.

(7) Remove valve.

(8) Remove cable guard attached to valve.

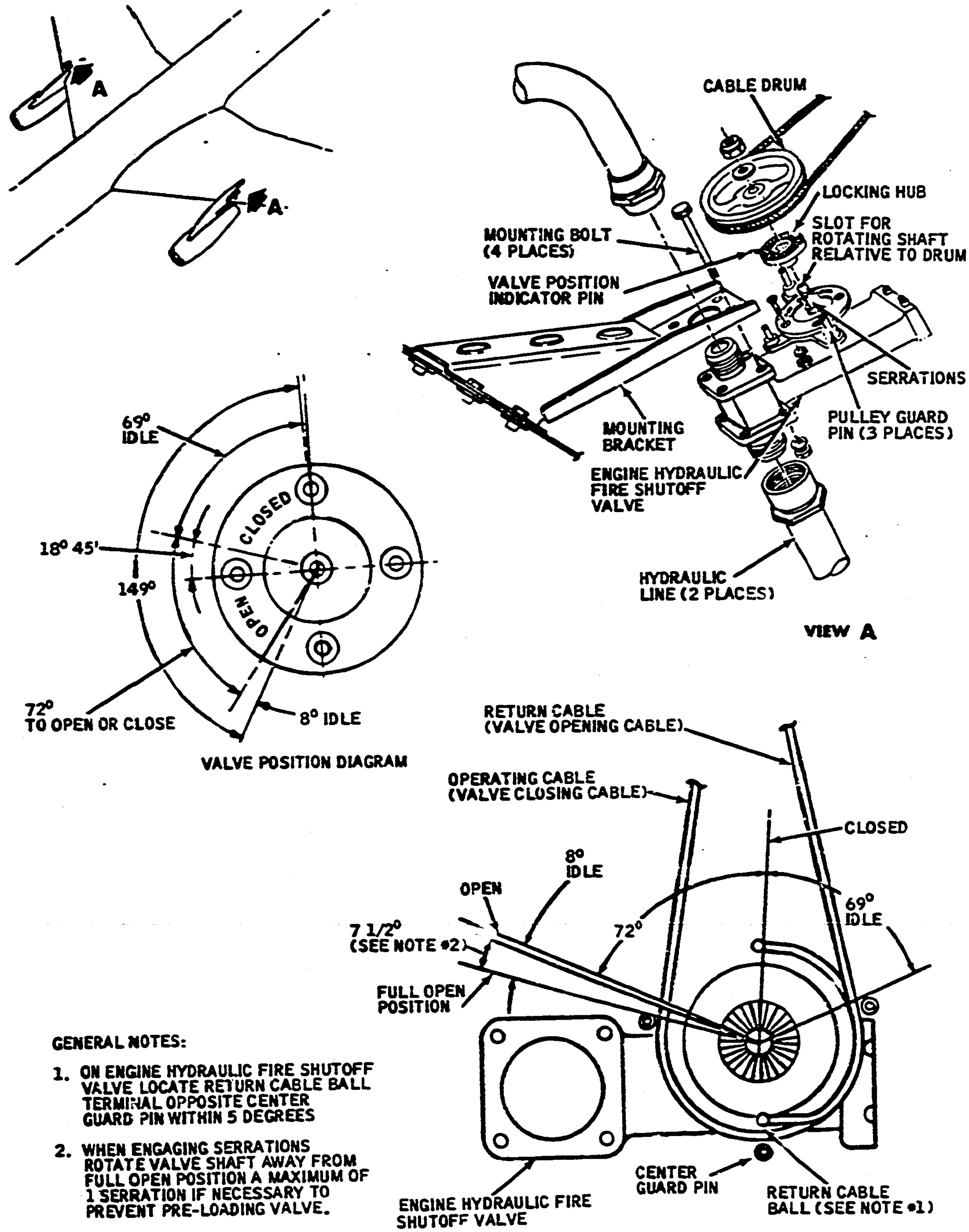
B. Install Fire Shutoff Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Check fire shutoff valve for condition and operation.

(3) Install cable guard on valve.

(4) Install valve.



GENERAL NOTES:

1. ON ENGINE HYDRAULIC FIRE SHUTOFF VALVE LOCATE RETURN CABLE BALL TERMINAL OPPOSITE CENTER GUARD PIN WITHIN 5 DEGREES
2. WHEN ENGAGING SERRATIONS ROTATE VALVE SHAFT AWAY FROM FULL OPEN POSITION A MAXIMUM OF 1 SERRATION IF NECESSARY TO PREVENT PRE-LOADING VALVE.

Engine Hydraulic Fire Shutoff
Valve -- Installation
Figure 201

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(5) Connect hydraulic lines to inlet and outlet ports of valve.

(6) Make certain that applicable fire control handle is in normal (open) position and insert rig pin in wing inboard transition drum (see Chapter 76).

(7) Install cable drum on valve shaft and partially tighten attaching nut. Do not engage serrations in cable drum with serrations in locking hub.

(8) Differentially adjust turnbuckles to place ball end of return cable opposite center guard pin in guard within ±5 degrees. Adjust cables to tension as specified in cable tension chart (see 29-10-0, Figure 502).

(9) Tighten cable drum attaching nut with valve in full open position.

CAUTION: DO NOT PRELOAD VALVE AGAINST STOP.

NOTE: The locking hub on the engine hydraulic fire shutoff valve can be rotated a maximum of 7 1/2 degrees (one serration) from the full-open position to mesh the serrations in the cable drum with the serrations in the locking hub.

(10) Safety turnbuckles with lockwire and remove rig pin from transition drum.

(11) Close auxiliary hydraulic pump control circuit breaker.

3. Inspection/Check Engine Hydraulic Fire Shutoff Valve

A. Check Fire Shutoff Valve

(1) Place fire control handle in fuel, air, and hydraulic off position.

(2) Disconnect hydraulic pressure and supply hoses at applicable inboard pylon firewall.

(3) Connect hydraulic test stand pressure and supply hoses to firewall connections.

(4) Place fire control handle in normal position.

(5) Pressurize hydraulic system with test stand set at full flow (20 gpm) (see 29-00, Maintenance Practices).

(6) Place fire control handle in fuel, air, and hydraulic off position. Hydraulic fluid flow through fire shutoff valve should stop.

CAUTION: DO NOT RUN TEST STAND PUMP FOR MORE THAN 30 SECONDS WITH FIRE SHUTOFF VALVE CLOSED.

(7) Place fire control handle in normal position. Fluid flow should resume.

(8) Shut off hydraulic test stand.

(9) Place fire control handle in fuel, air, and hydraulic off position.

(10) Disconnect test stand pressure and supply hoses from firewall connections.

(11) Connect engine pump hoses to firewall connections.

(12) With fire control handles in fuel, air, and hydraulic off position, indicators on valves should be in overtravel range.

(13) Place fire control handles in normal position, check that indicators on valves are in pretravel range.

(14) Reset generator (see Chapter 24).

(15) Check lines and fittings to fire shutoff valves for security of attachment and leaks.

(16) Check cable drum and cables for security of attachment, wear, and corrosion.

(17) Check that cable turnbuckles are properly lockwired.

ENGINE HYDRAULIC FIRE SHUTOFF VALVE - MAINTENANCE PRACTICES

1. General

A. The two engine hydraulic fire shutoff valves are located in the wing leading edge, one valve aft of the firewall of each inboard pylon.

B. Access to the valves is through access doors located on the lower side of the wing leading edge, outboard of either the left or right inboard pylon. The valves are located inboard of the access door.

C. The removal/installation and inspection/check procedures for the left or right fire shutoff valves are identical. Maintenance practices concerning the fire shutoff valve cable system are covered in Chapter 76.

2. Removal/Installation Engine Hydraulic Fire Shutoff Valves

A. Remove Fire Shutoff Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

(4) Loosen turnbuckles, located in wing leading edge inboard or inboard pylons (see Chapter [illegible].

(5) Remove nut and washer attaching cable drum to locking hub on hydraulic fire shutoff valve and remove cable drum from hub.

(6) Disconnect hydraulic lines from inlet and outlet ports of valve.

(7) Remove valve.

(8) Remove cable guard attached to valve.

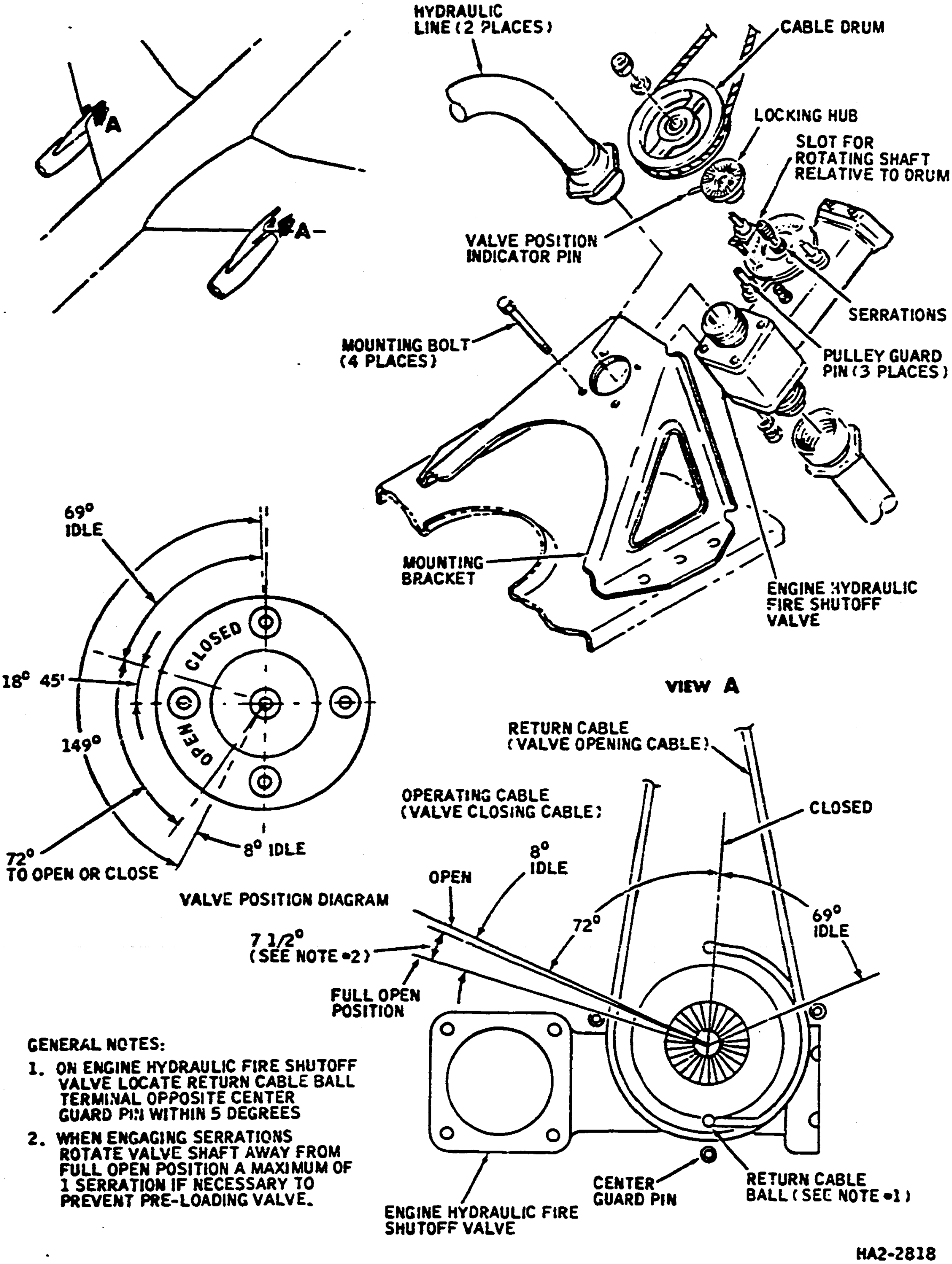
B. Install Fire Shutoff Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Check fire shutoff valve for condition and operation.

(3) Install cable guard on valve.

(4) Install valve.



GENERAL NOTES:

1. ON ENGINE HYDRAULIC FIRE SHUTOFF VALVE LOCATE RETURN CABLE BALL TERMINAL OPPOSITE CENTER GUARD PIN WITHIN 5 DEGREES
2. WHEN ENGAGING SERRATIONS ROTATE VALVE SHAFT AWAY FROM FULL OPEN POSITION A MAXIMUM OF 1 SERRATION IF NECESSARY TO PREVENT PRE-LOADING VALVE.

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Engine Hydraulic Fire Shutoff
Valve -- Installation
Figure 201

(5) Connect hydraulic lines to inlet and outlet ports of valve.

(6) Make certain that applicable fire control handle is in normal (open) position and insert rig pin in wing inboard transition drum (see Chapter 76).

(7) Install cable drum on valve shaft and partially tighten attaching nut. Do not engage serrations in cable drum with serrations in locking hub.

(8) Differentially adjust turnbuckles to place ball end of return cable opposite center guard pin in guard within ±5 degrees. Adjust cables to tension as specified in cable tension chart (see 29-10-0, Figure 502).

(9) Tighten cable drum attaching nut with valve in full open position.

CAUTION: DO NOT PRELOAD VALVE AGAINST STOP.

NOTE: The locking hub on the engine hydraulic fire shutoff valve can be rotated a maximum of 7 1/2 degrees (one serration) from the full-open position to mesh the serrations in the cable drum with the serrations in the locking hub.

(10) Safety turnbuckles with lockwire and remove rig pin from transition drum.

(11) Close auxiliary hydraulic pump control circuit breaker.

3. Inspection/Check Engine Hydraulic Fire Shutoff Valve

A. Check Fire Shutoff Valve

(1) Place fire control handle in fuel, air, and hydraulic off position.

(2) Disconnect hydraulic pressure and supply hoses at applicable inboard pylon firewall.

(3) Connect hydraulic test stand pressure and supply hoses to firewall connections.

(4) Place fire control handle in normal position.

(5) Pressurize hydraulic system with test stand set at full flow (20 gpm) (see 29-00, Maintenance Practices).

(6) Place fire control handle in fuel, air, and hydraulic off position. Hydraulic fluid flow through fire shutoff valve should stop.

CAUTION: DO NOT RUN TEST STAND PUMP FOR MORE THAN 30 SECONDS WITH FIRE SHUTOFF VALVE CLOSED.

(7) Place fire control handle in normal position. Fluid flow should resume.

(8) Shut off hydraulic test stand.

(9) Place fire control handle in fuel, air, and hydraulic off position.

(10) Disconnect test stand pressure and supply hoses from firewall connections.

(11) Connect engine pump hoses to firewall connections.

(12) With fire control handles in fuel, air, and hydraulic off position, indicators on valves should be in overtravel range.

(13) Place fire control handles in normal position, check that indicators on valves are in pretravel range.

(14) Reset generator (see Chapter 24).

(15) Check lines and fittings to fire shutoff valves for security of attachment and leaks.

(16) Check cable drum and cables for security of attachment, wear, and corrosion.

(17) Check that cable turnbuckles are properly lockwired.

ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors.

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm, Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connector from bypass solenoid.

(7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/9? grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connector to bypass solenoid.

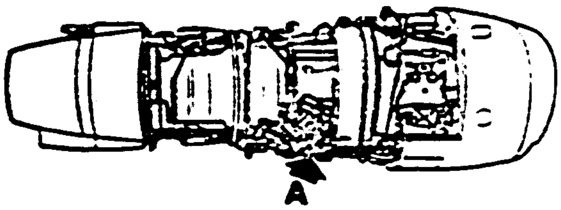
(11) Place fire control handles in normal position.

(12) Bleed entrapped air from suction hose of pump.

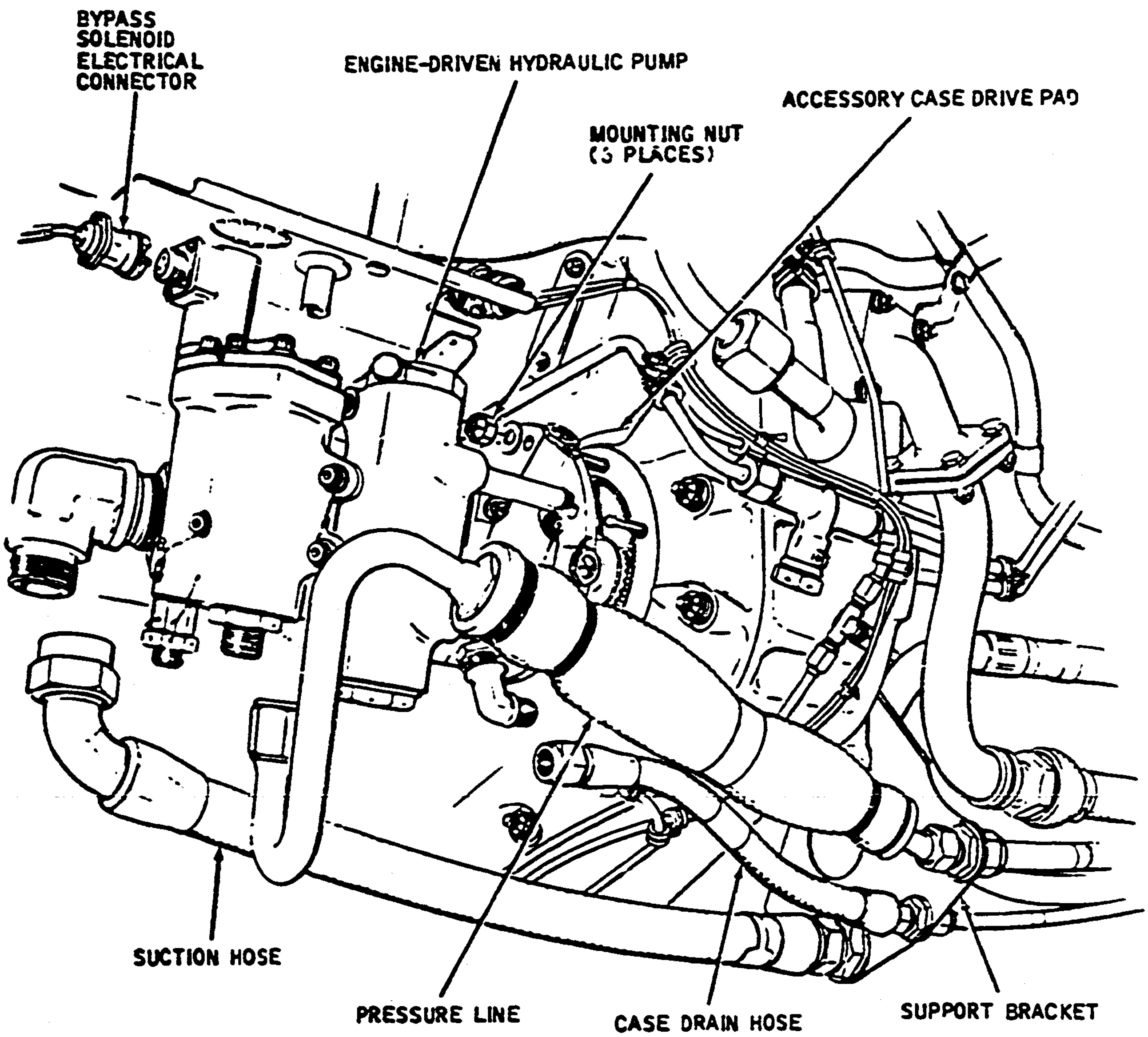
(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellanecus (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).



RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)



VIEW A

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Engine Driven Hydraulic Pump -- Installation
Figure 201

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pumps, hoses, and fittings for leaks.

(12) Check hose connections and pumps for security of attachment.

(13) Check electrical connectors on bypass solenoids for security of attachment and general condition.

ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors.

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm, Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connectors from bypass solenoid and low pressure switch.

(7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connectors to bypass solenoid and low pressure switch.

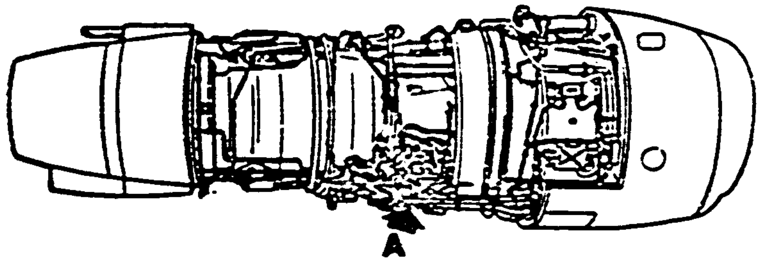
(11) Place fire control handles in normal position.

(12) Bleed entrapped air from suction hose of pump.

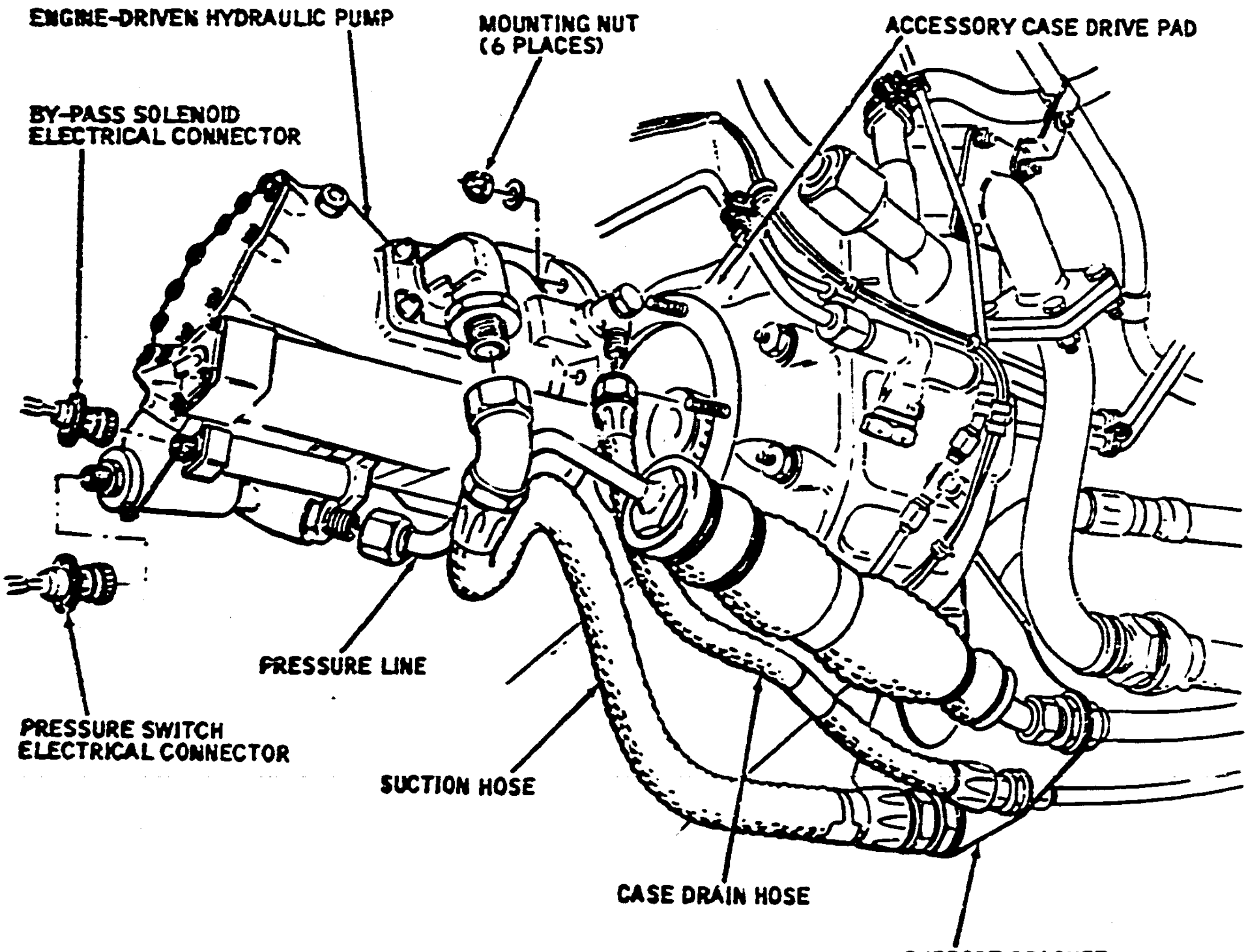
(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).



RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)



VIEW A

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Engine-Driven Hydraulic Pump -- Installation
Figure 201

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pumps, hoses, and fittings for leaks.

(12) Check hose connections and pumps for security of attachment.

(13) Check electrical connectors on bypass solenoids and low pressure switches for security of attachment and general condition.

ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors and removal of the engine bypass duct (see Chapter 78).

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm, Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connector from bypass solenoid.

(7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connector to bypass solenoid.

(11) Place fire control handles in normal position.

(12) Bleed entrapped air from suction hose at pump.

(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).

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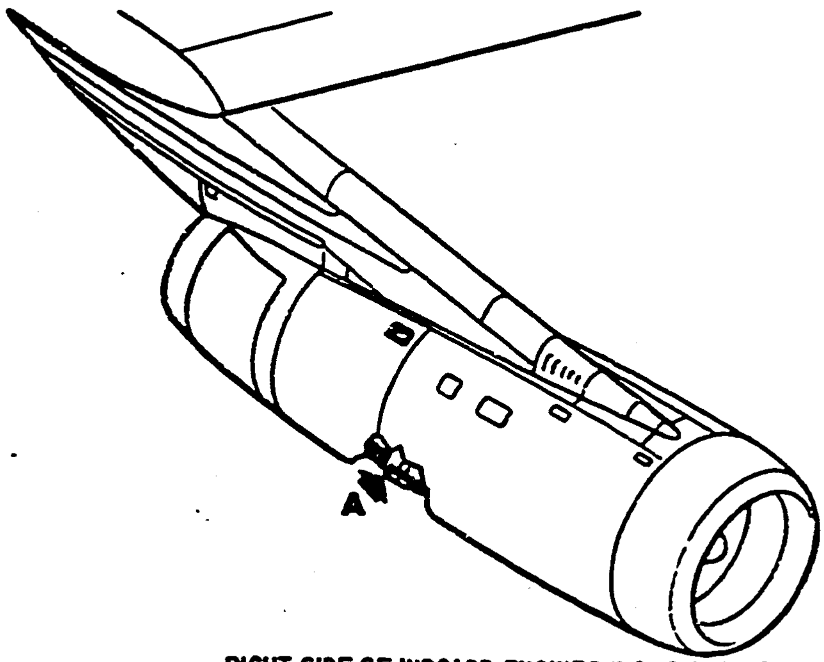
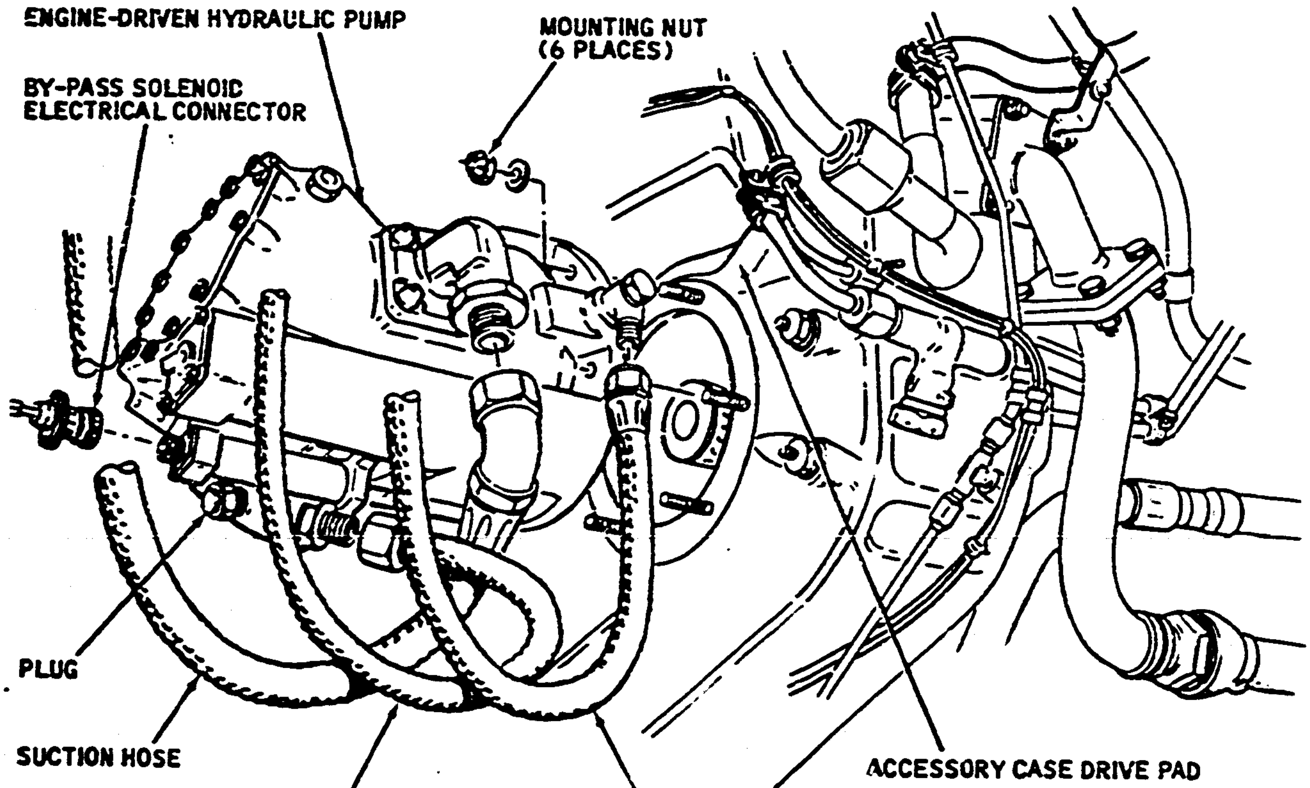


RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)



VIEW A

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Engine-Driven Hydraulic Pump -- Installation
Figure 201

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pumps, hoses, and fittings for leaks.

(12) Check hose connections and pumps for security of attachment.

(13) Check electrical connectors on bypass solenoids for security of attachment and general condition.

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ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors.

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connector from bypass solenoid.

(7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

<u>NOTE</u>: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

<u>CAUTION</u>: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

<u>CAUTION</u>: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connector to bypass solenoid.

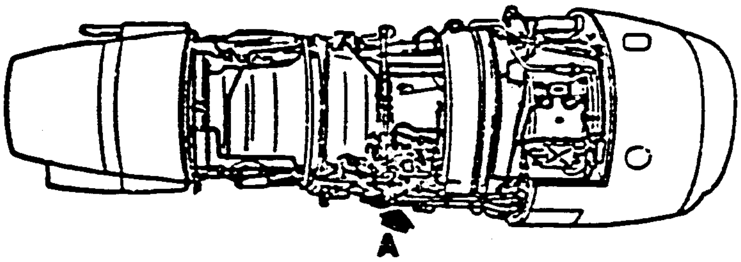
(11) Place fire control handles in normal position.

(12) Bleed entrapped air from suction hose of pump.

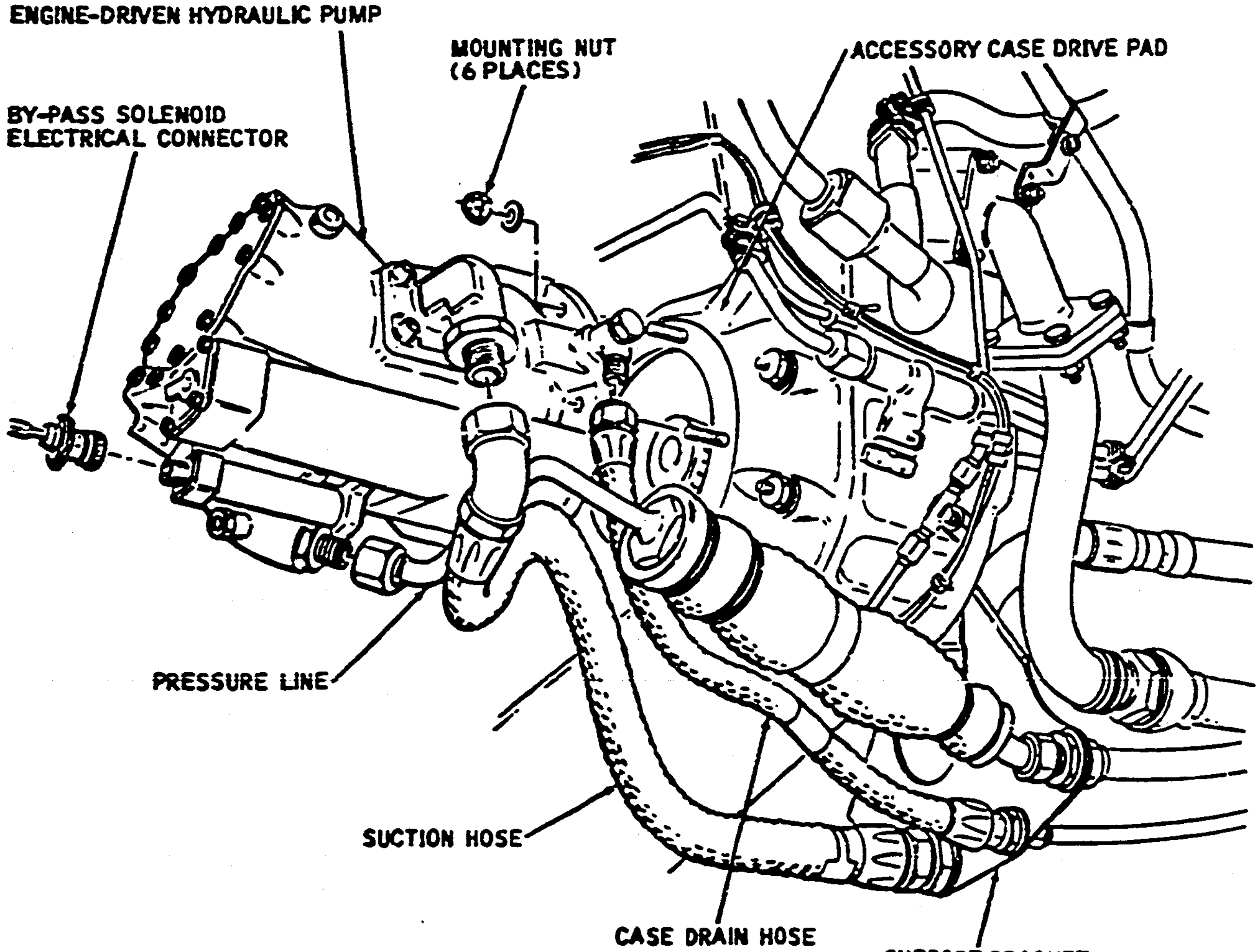
(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).



RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)



VIEW A

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Engine-Driven Hydraulic Pump -- Installation
Figure 201

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engine No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pump, hoses, and fittings for leaks.

(12) Check hose connections and pump for security of attachment.

(13) Check electrical connector on bypass solenoid for security of attachment and general condition.

ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors and removal of the engine bypass duct (see Chapter 78).

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connectors from bypass solenoid and low pressure switch.

(7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connectors to bypass solenoid and low pressure switch.

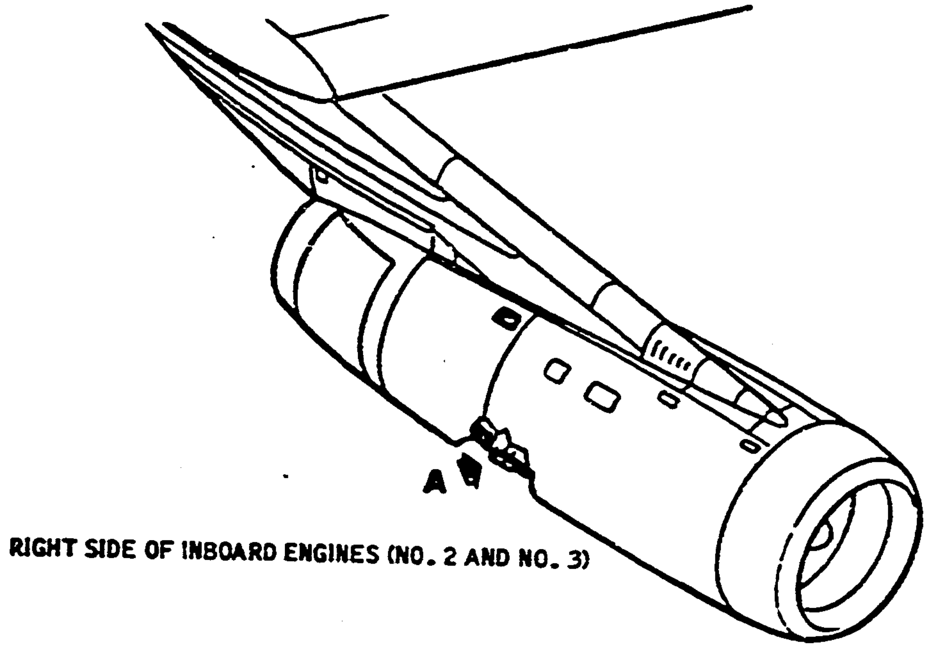
(11) Place fire control handles in normal position.

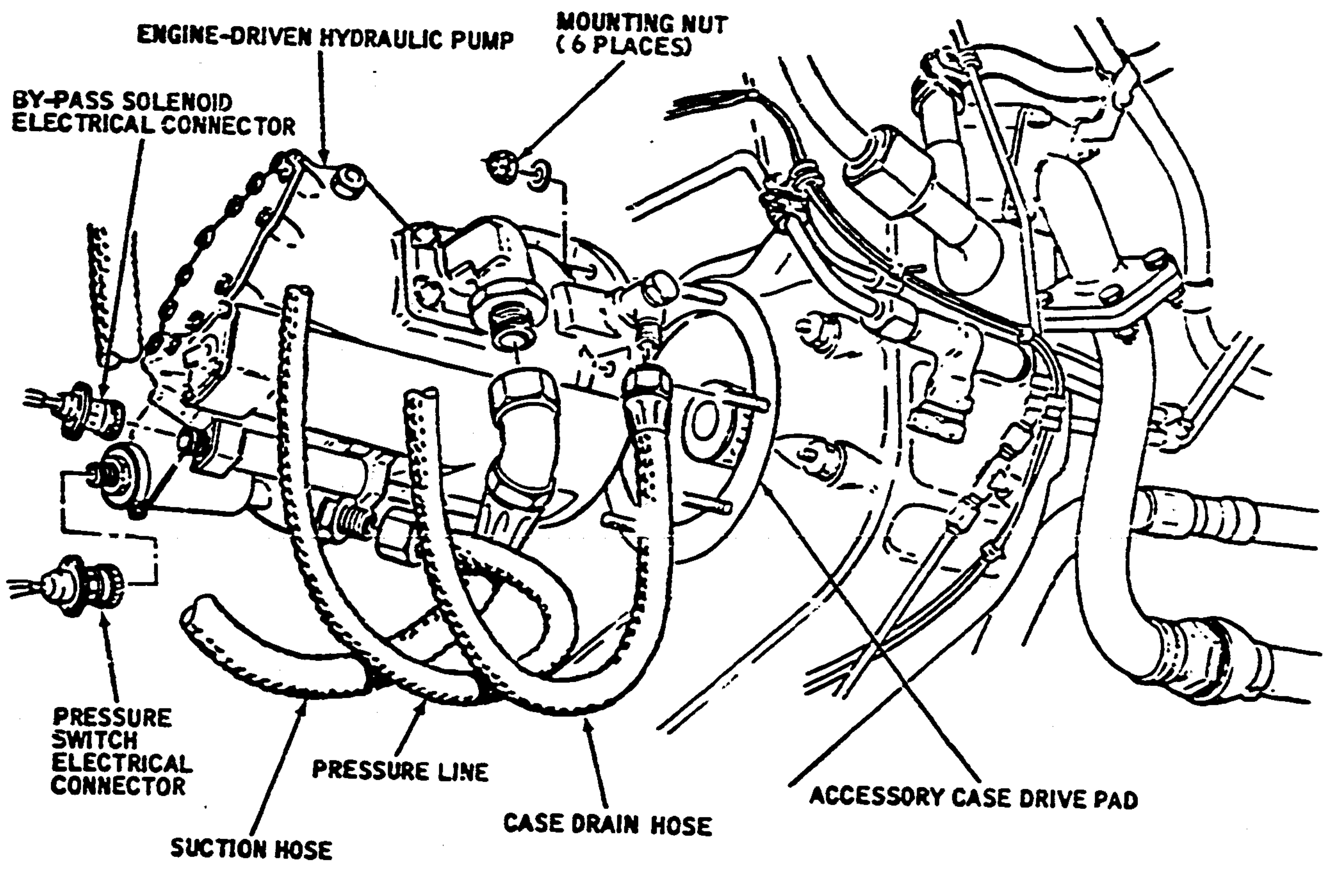
(12) Bleed entrapped air from suction hose of pump.

(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).





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Engine-Driven Hydraulic Pump -- Installation
Figure 201

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system normal position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pump, hoses, and fittings for leaks.

(12) Check hose connections and pump for security of attachment.

(13) Check electrical connectors on bypass solenoid and low pressure switch for security of attachment and general condition.

ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors.

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connector from bypass solenoid.

(7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connector to bypass solenoid.

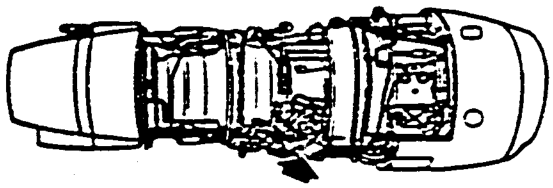
(11) Place fire control handles in normal position.

(12) Bleed entrapped air from suction hose of pump.

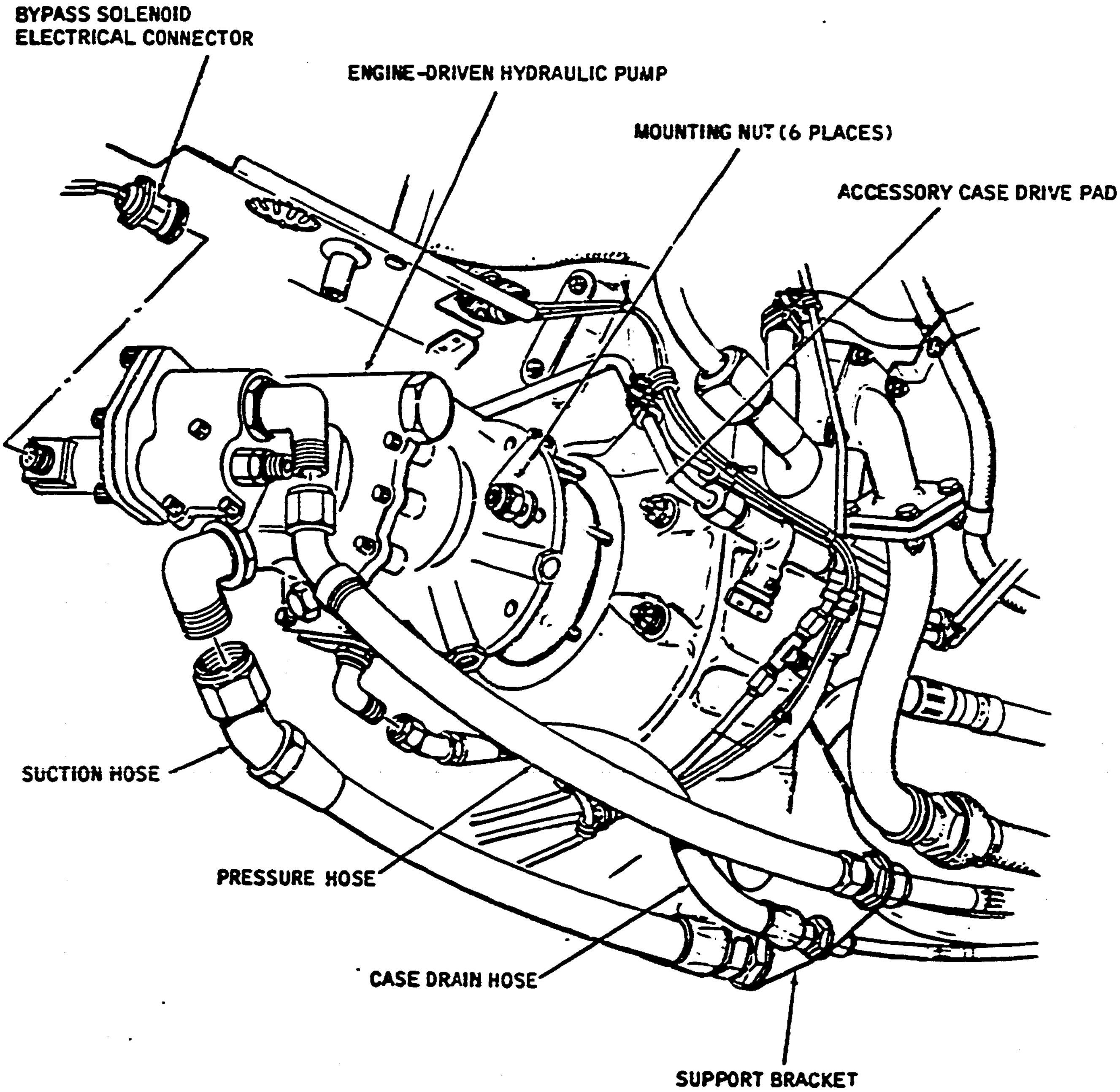
(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).



RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)



HA2-4462A

Engine Driven Hydraulic Pump -- Installation
Figure 201

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pumps, hoses, and fittings for leaks.

(12) Check hose connections and pumps for security of attachment.

(13) Check electrical connectors on bypass solenoids for security of attachment and general condition.

ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors.

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connector from bypass solenoid.

(7) Remove pump.

(8) Remove heat shield from pump (airplanes 812-815).

(9) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Install heat shield on pump (airplanes 812-815).

(5) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(6) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(7) Connect pressure line hose to pump outlet port.

(8) Connect suction hose to pump suction port.

(9) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(10) Connect case drain hose to pump case drain port.

(11) Connect electrical connector to bypass solenoid.

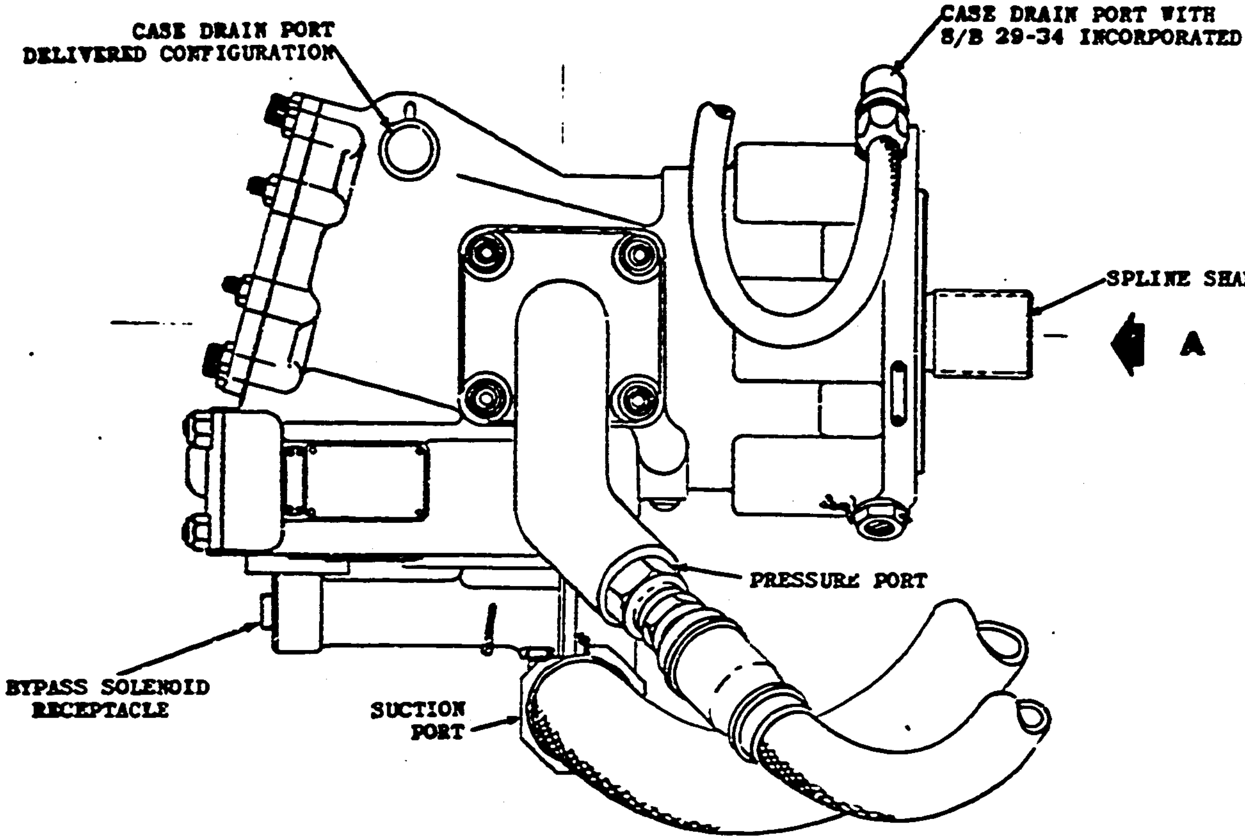
(12) Place fire control handles in normal position.

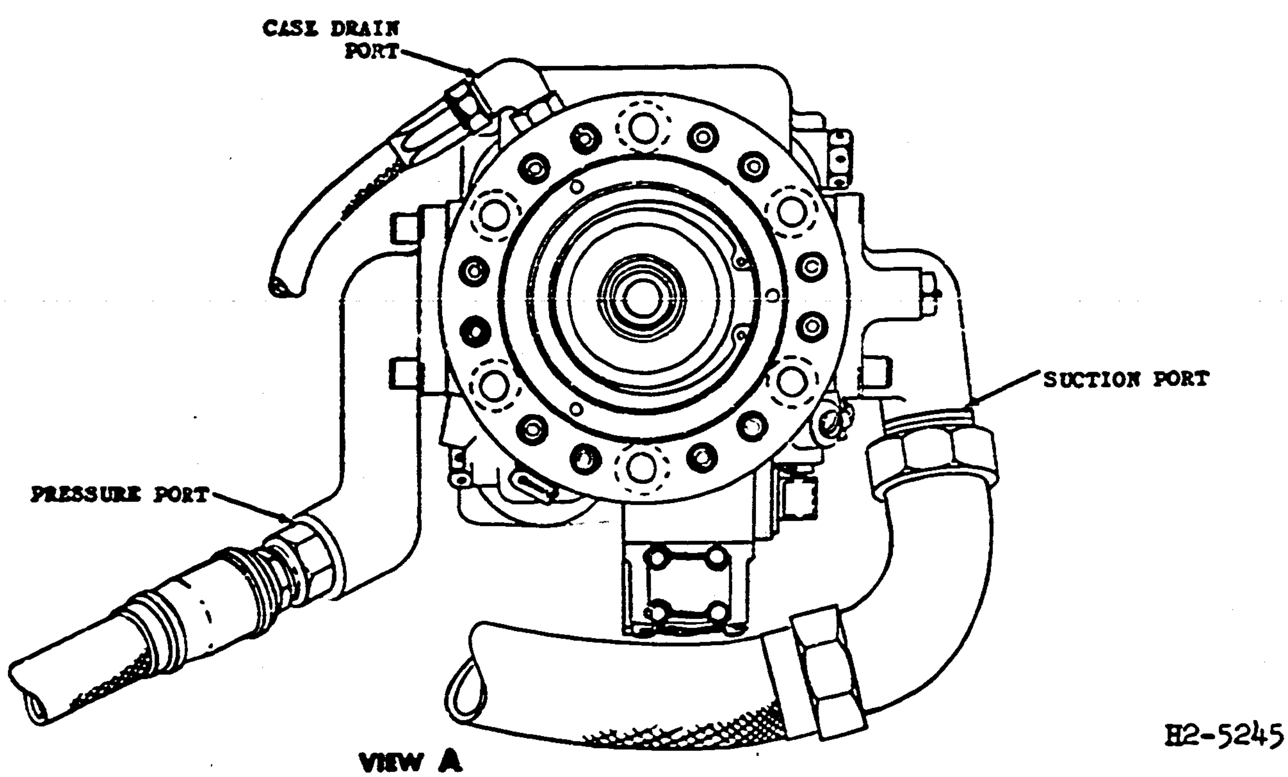
(13) Bleed entrapped air from suction hose of pump.

(14) Reset generator (see Chapter 24).

(15) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

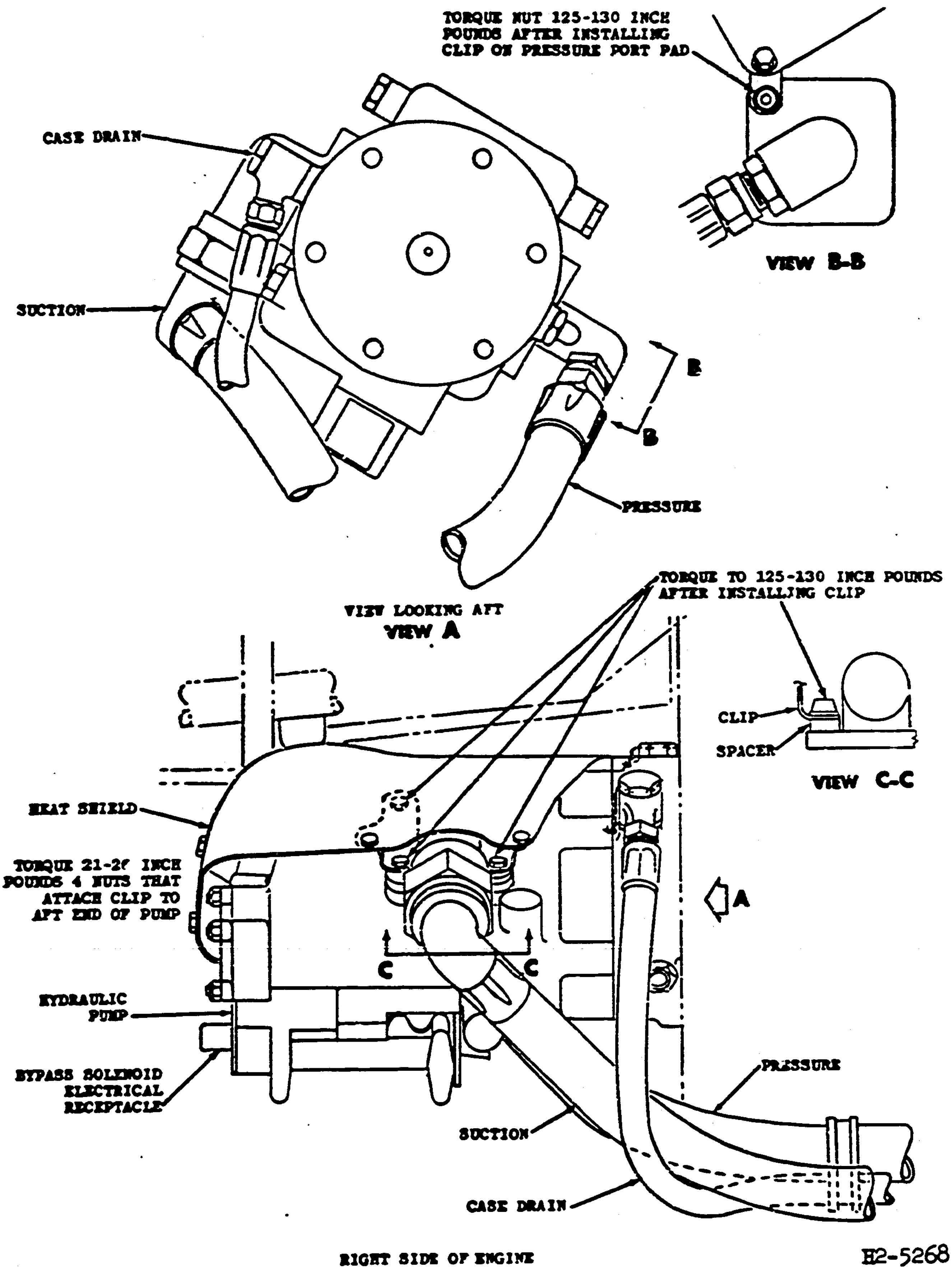
(16) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).



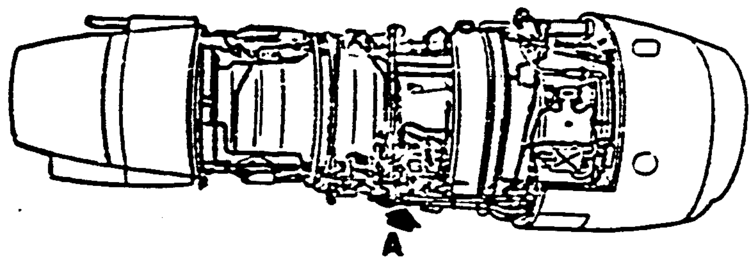


VIEW A

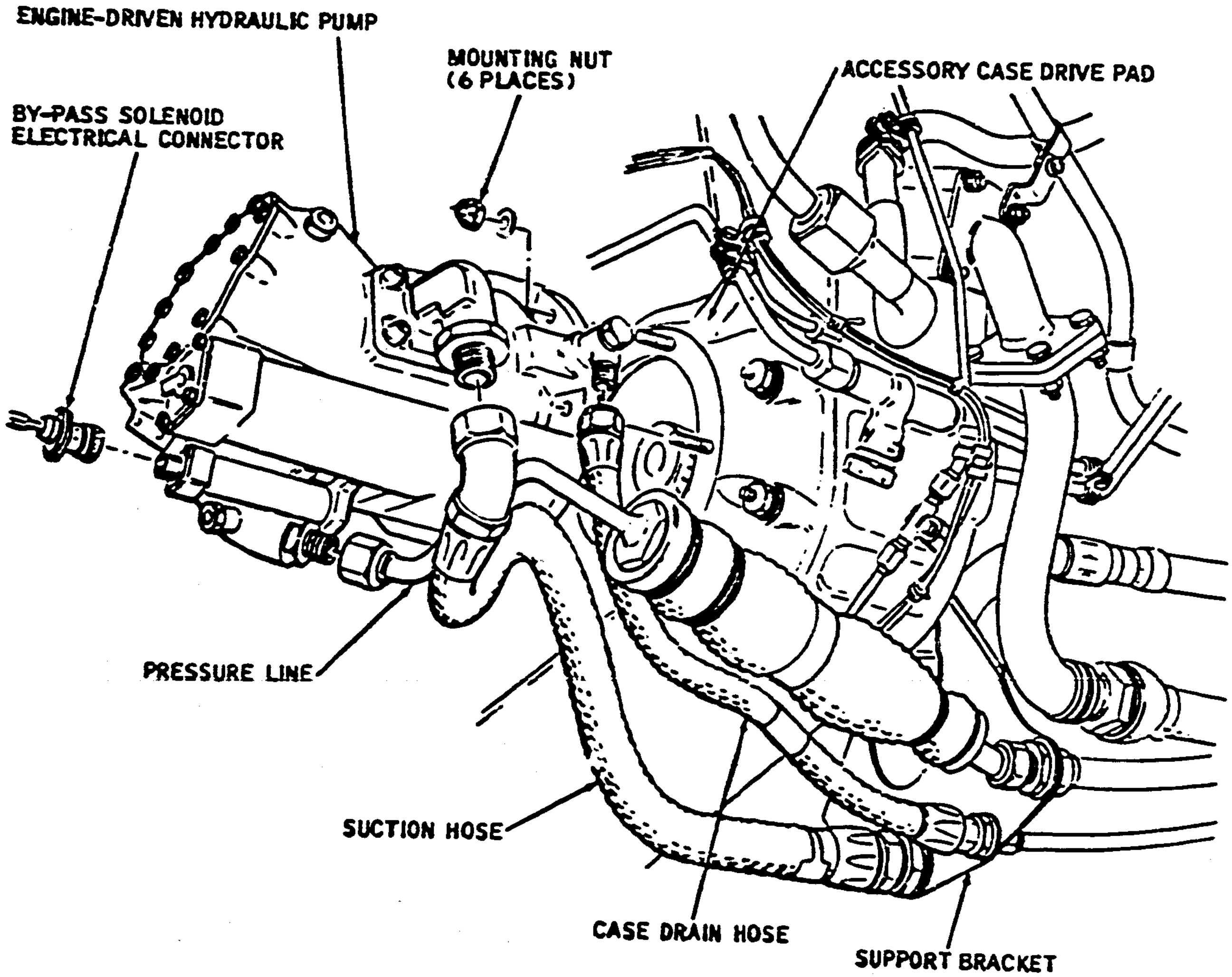
Engine Driven Hydraulic Pump -- External View
(Airplanes 801-811)
Figure 201 (Sheet 1)



Engine Driven Hydraulic Pump -- External View
(Airplanes 812-815)
Figure 201 (Sheet 2)



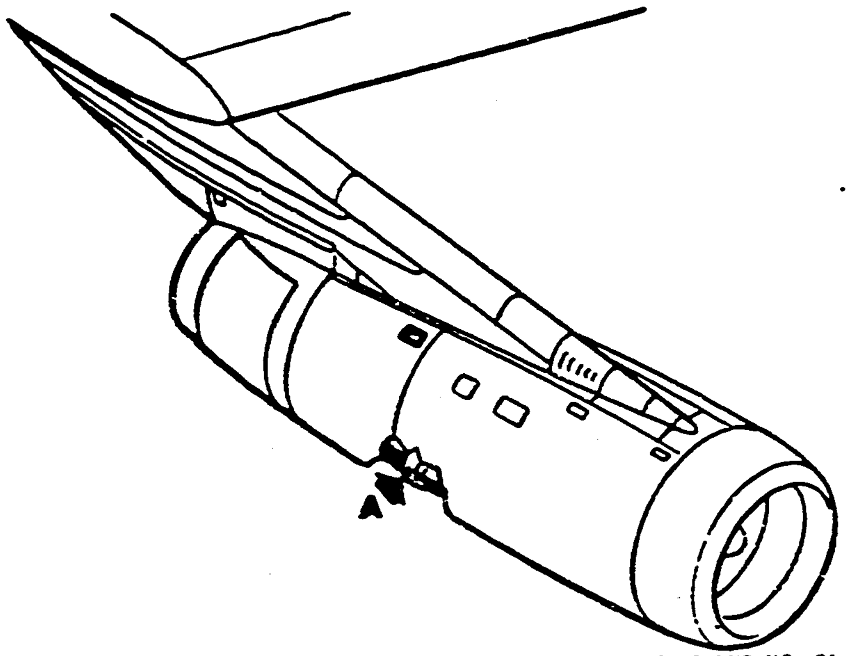
RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)



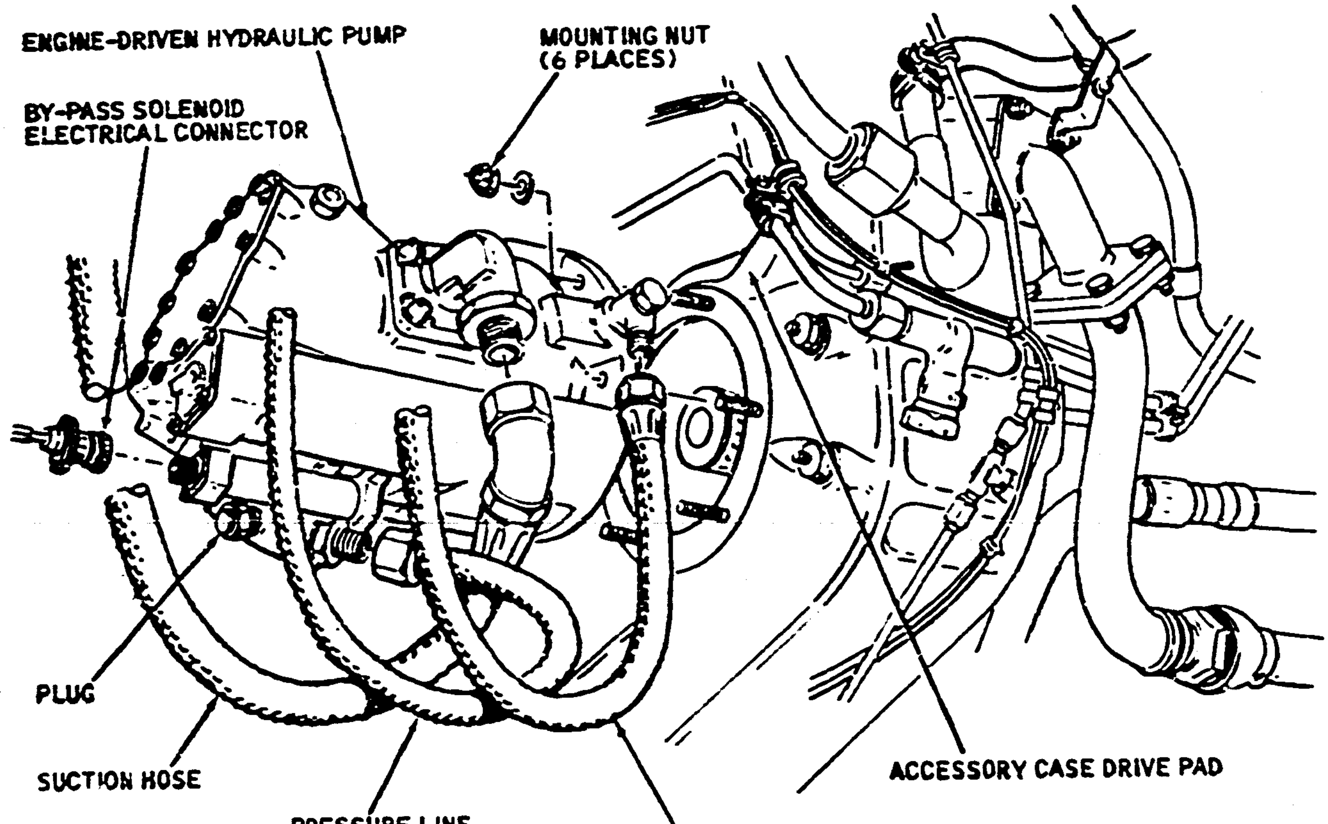
VIEW A

HA2-2153

Engine-Driven Hydraulic Pump -- Installation
(Airplanes 816-822, 860-866)
Figure 201 (Sheet 3)



RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)



VIEW A

HA2-1342

Engine-Driven Hydraulic Pump -- Installation
(Airplanes 867 and Subsequent)
Figure 201 (Sheet 4)

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4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engine No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in [illegible]osition for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pump, hoses, and fittings for leaks.

(12) Check hose connections and pump for security of attachment.

(13) Check electrical connector on bypass solenoid for security of attachment and general condition.

ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors and removal of the engine bypass duct (see Chapter 78).

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connector from bypass solenoid.

(7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel are open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connector to bypass solenoid.

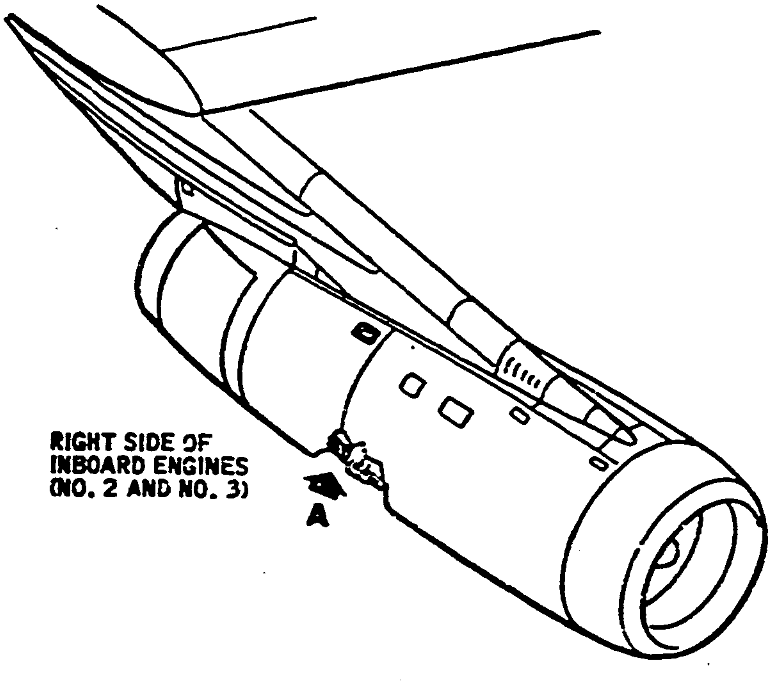
(11) Place fire control handles in normal position.

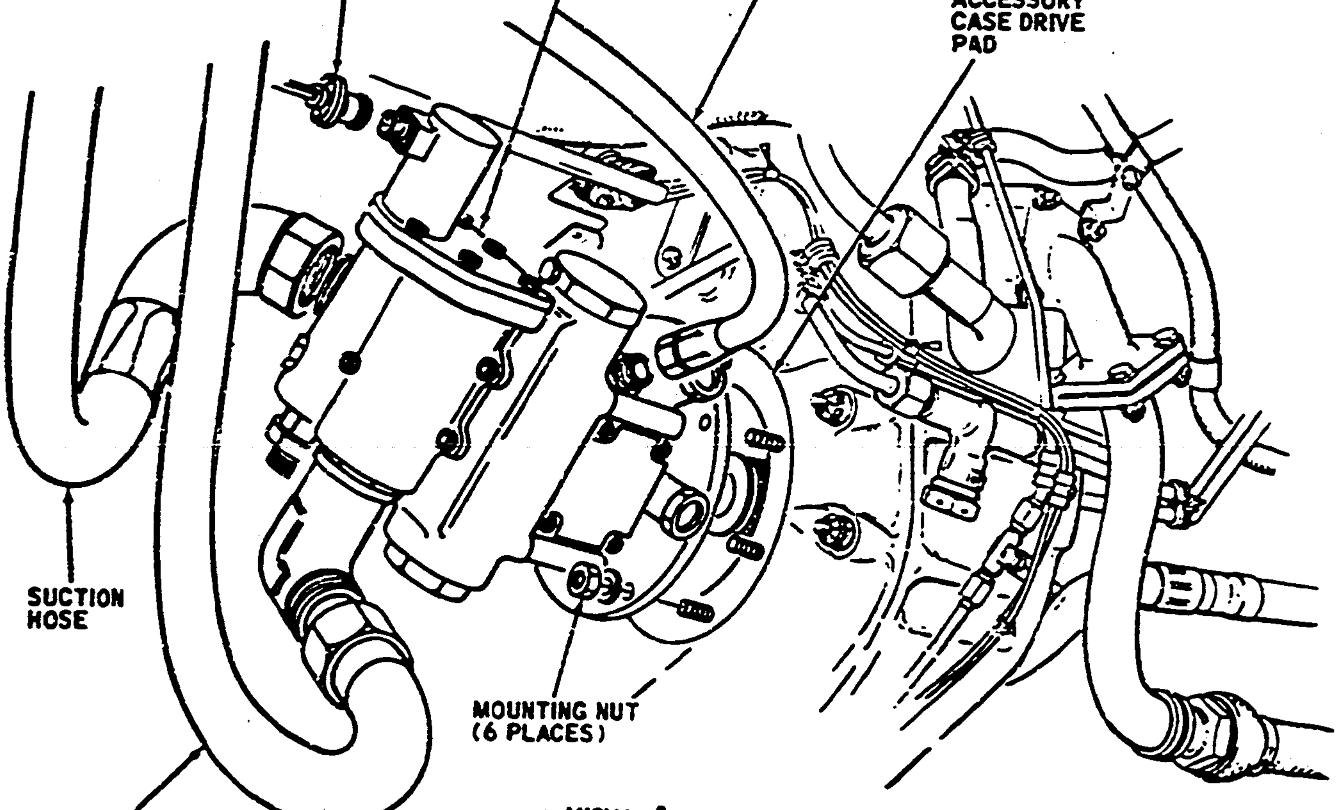
(12) Bleed entrapped air from suction hose of pump.

(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).





VIEW A

HA2-4735

Engine Driven Hydraulic Pump -- Installation
Figure 201

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pumps, hoses, and fittings for leaks.

(12) Check hose connections and pumps for security of attachment.

(13) Check electrical connectors on bypass solenoids for security of attachment and general condition.

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ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

   A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

   B. Access to the hydraulic pumps is through the engine nacelle doors.

   C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

   A. Grease, Electro-Moly/92 (Electrofilm Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

   A. Remove Engine-Driven Hydraulic Pump

      (1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Place fire control handles in fuel, air, and hydraulic off position.

      (3) Disconnect case drain hose from case drain port.

      CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

      (4) Disconnect pressure line from outlet port.

      (5) Disconnect suction hose from suction port.

      (6) Disconnect electrical connectors from bypass solenoid and low pressure switch.

      (7) Remove pump.

(8) Remove hydraulic fittings from pump ports and retain for use on new pump.

NOTE: In the event an engine-driven hydraulic pump is operated without fluid, or if operated when main reservoir fluid level is less than 5 gallons, the pump(s) and its associated components, listed below, must be replaced prior to further service. Also, in the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel is open.

(2) Install fittings in pump pressure, suction, and case drain ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

<u>CAUTION</u>: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Connect case drain hose to pump case drain port.

(10) Connect electrical connectors to bypass solenoid and low pressure switch.

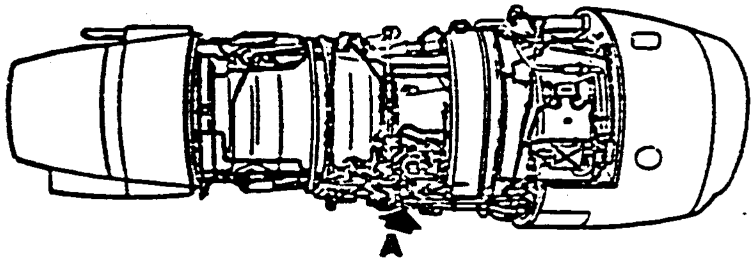
(11) Place fire control handles in normal position.

(12) Bleed entrapped air from suction hose of pump.

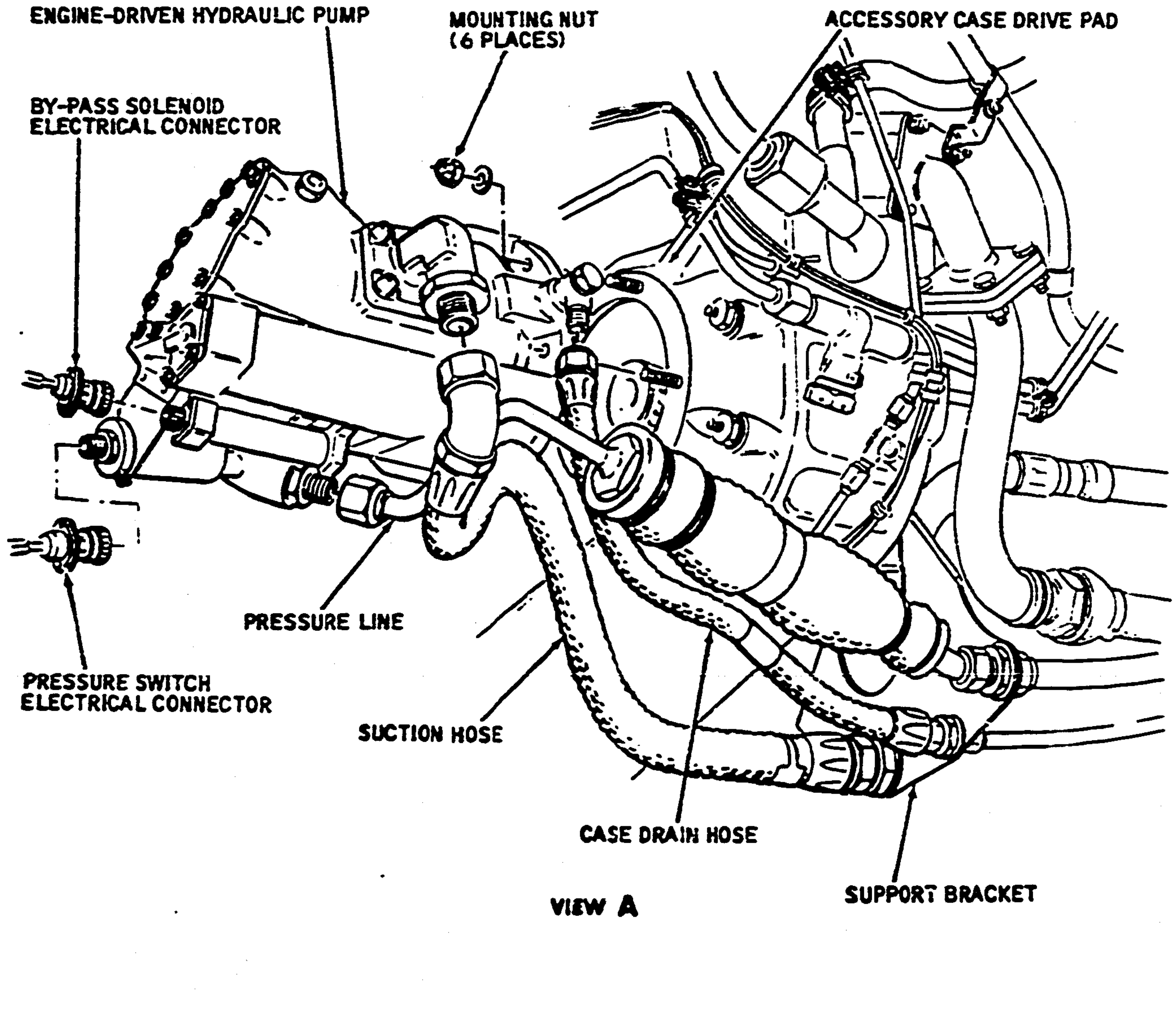
(13) Reset generator (see Chapter 24).

(14) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(15) Check operation of engine-driven hydraulic pump during next scheduled engine run (see Paragraph 4).



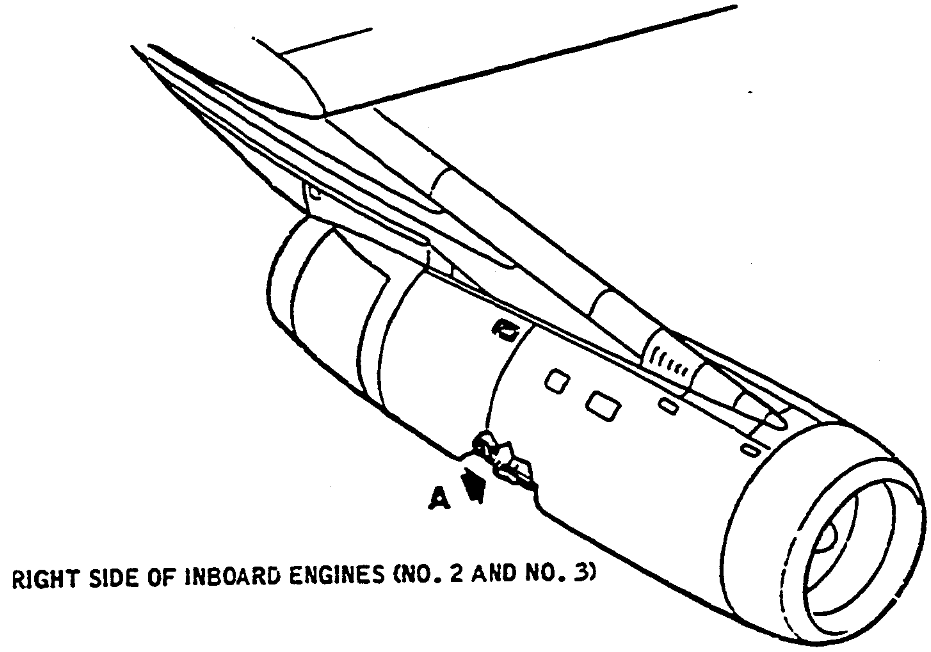
RIGHT SIDE OF INBOARD ENGINES (NO. 2 AND NO. 3)

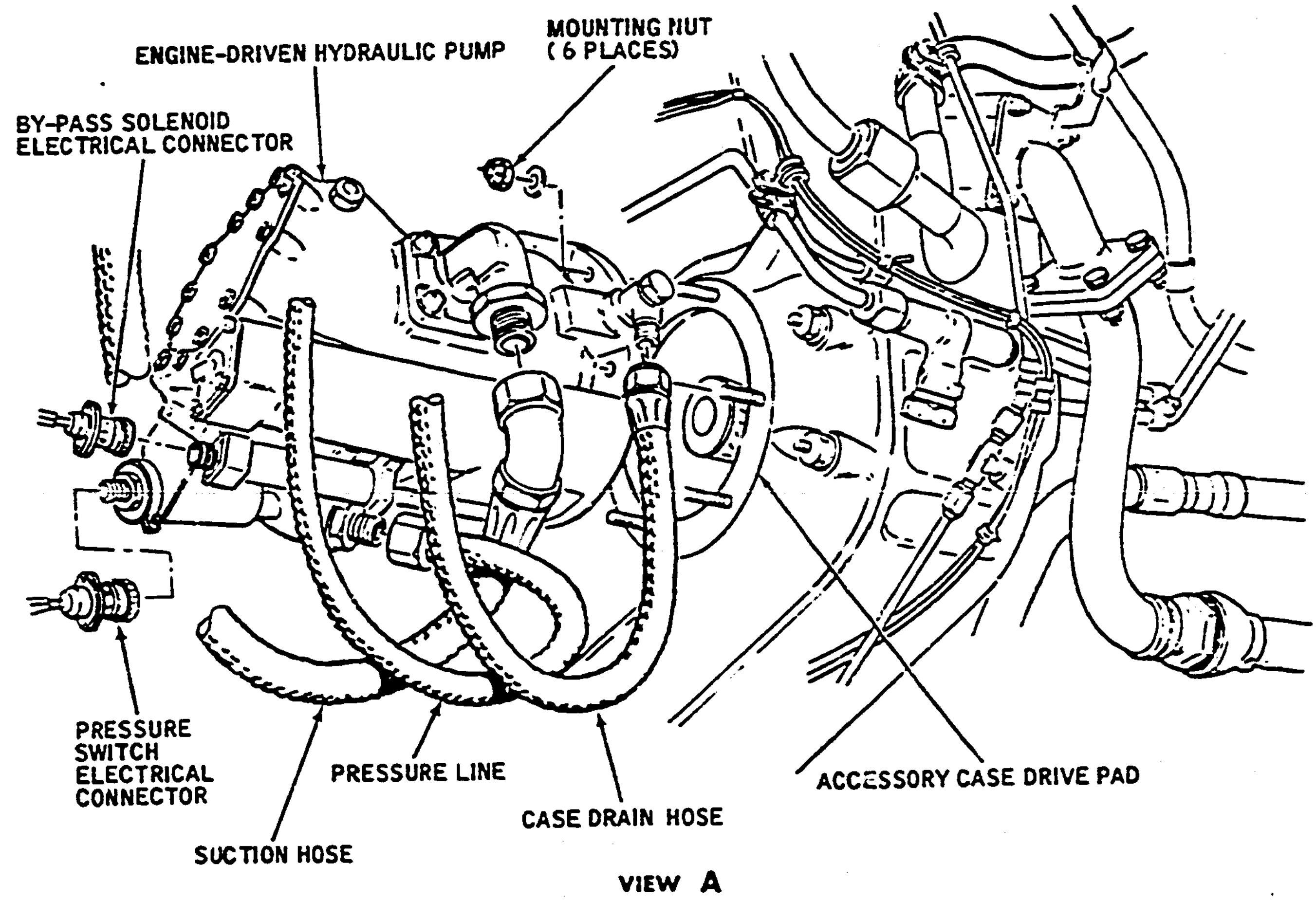


VIEW A

HA2-1343

Engine-Driven Hydraulic Pump -- Installation
(Airplanes N8762-N8778)
Figure 201 (Sheet 1)





HA2-2193

Engine-Driven Hydraulic Pump -- Installation
(Airplanes N7855-N7860)
Figure 201 (Sheet 2)

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pumps, hoses, and fittings for leaks.

(12) Check hose connections and pumps for security of attachment.

(13) Check electrical connectors on bypass solenoids and low pressure switches for security of attachment and general condition.

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ENGINE-DRIVEN HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pumps are located, one each, on the accessory drive case of each inboard engine.

B. Access to the hydraulic pumps is through the engine nacelle doors and removal of the engine bypass duct (see Chapter 78).

C. Removal/installation procedures for the left and right engine-driven hydraulic pumps are identical, except as noted. Inspection/check procedures for the left and right engine-driven hydraulic pumps are identical.

2. Tools and Equipment Required

A. Grease, Electro-Moly/92 (Electrofilm Incorp.), or equivalent, is used for lubrication of hydraulic pump shaft splines.

3. Removal/Installation Engine-Driven Hydraulic Pumps

A. Remove Engine-Driven Hydraulic Pump

(1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Place fire control handles in fuel, air, and hydraulic off position.

(3) Disconnect case drain hose from disposable filter at case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(4) Disconnect pressure line from outlet port.

(5) Disconnect suction hose from suction port.

(6) Disconnect electrical connector from bypass solenoid.

(7) Remove pump.

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(8) Remove hydraulic fittings and disposable filter from pump ports and retain for use on new pump.

NOTE: In the event the pump is removed due to a malfunction of the pump, and physical internal damage is suspected, the following filters and check valves should be removed and cleaned, or replaced.

(a) Dual filter and relief valve filter.

(b) Hydraulic reservoir return fluid filter.

(c) Engine-driven pump return line (case drain) check valve, located in pylon.

(d) Engine-driven pump pressure line check valve, located in pylon.

(e) Disposable case drain filter.

(f) Case drain filter and line check valve.

B. Install Engine-Driven Hydraulic Pump

(1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel are open.

(2) Install fittings in pump pressure and suction ports.

(3) Lubricate pump shaft splines with Electro-Moly/92 grease.

(4) Check gasket in pump mounting flange (on engine side) for general condition before installing pump.

(5) Install pump on engine accessory pad and secure.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(6) Connect pressure line hose to pump outlet port.

(7) Connect suction hose to pump suction port.

(8) Fill pump case with clean hydraulic fluid through case drain port.

CAUTION: BEFORE OPERATING THE ENGINE-DRIVEN HYDRAULIC PUMP, PUMP MUST BE FILLED WITH CLEAN HYDRAULIC FLUID THROUGH CASE DRAIN PORT TO PREVENT PUMP FROM OPERATING WITHOUT LUBRICATION DURING SELF-PRIMING PERIOD.

(9) Install disposable filter in case drain port.

(10) Connect case drain hose to disposable filter inlet port.

(11) Connect electrical connector to bypass solenoid.

(12) Place fire control handles in normal position.

(13) Bleed entrapped air from suction hose of pump.

(14) Reset generator (see Chapter 24).

(15) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(16) Check operation of engine-driven hydraulic pump during next scheduled engine run (see paragraph 4).

4. Inspection/Check Engine-Driven Hydraulic Pump

A. Check Engine-Driven Hydraulic Pump

(1) Start engines No. 2 and 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Operate wing flaps through a complete cycle of operation.

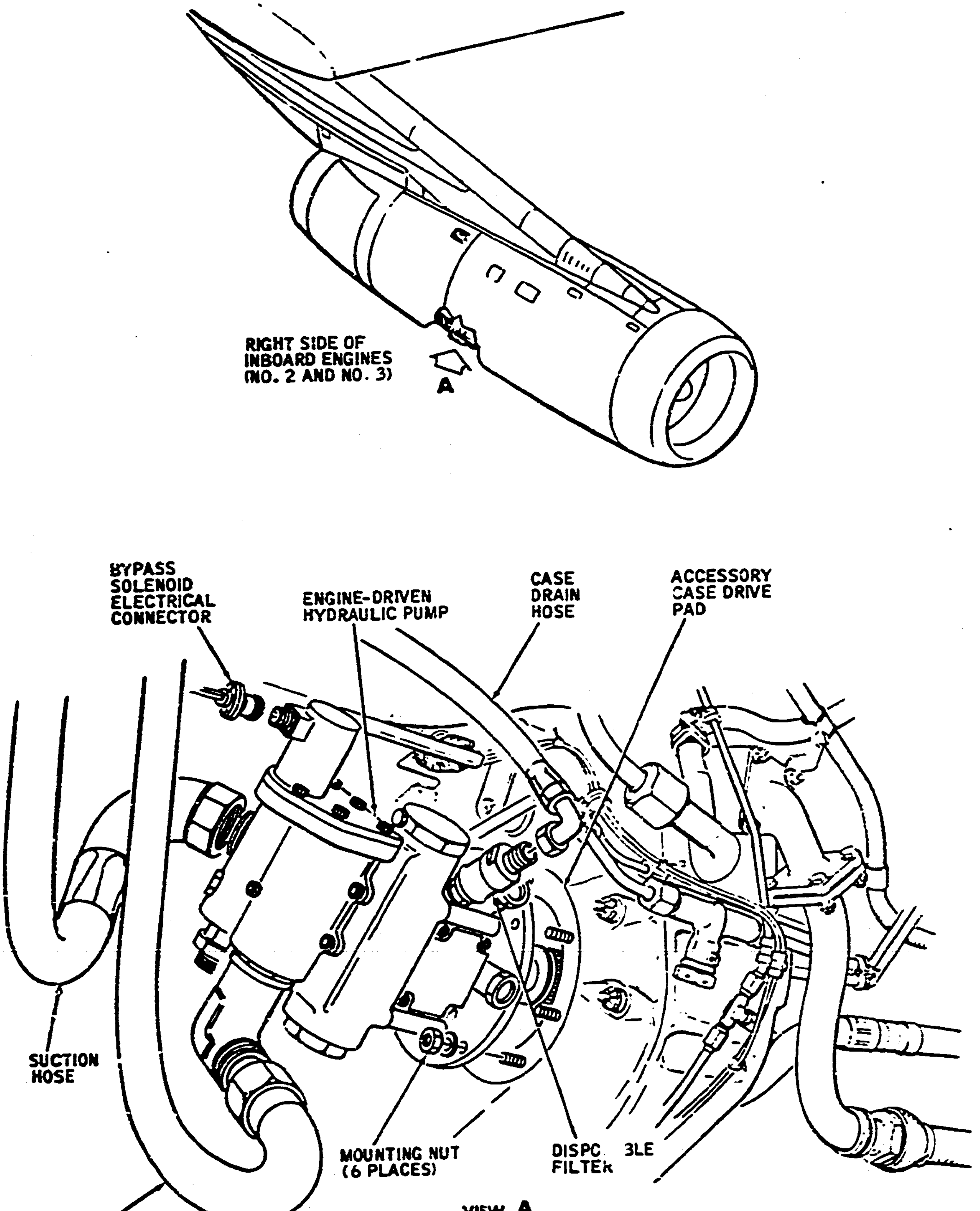
WARNING: BEFORE OPERATING FLAPS, MAKE CERTAIN THAT FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(5) Place both engine-driven pump control switches in bypass position. Hydraulic pressure should drop to approximately zero psi.

(6) Place one control switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.

(7) Return switch to bypass position.

(8) Place other switch in on position. Hydraulic pressure should build up to 2800- to 3000-psi.



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Engine Driven Hydraulic Pump -- Installation
Figure 201

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(9) Place both switches in on position for normal operation.

(10) Shut down engines (see Chapter 71).

(11) Check hydraulic pumps, hoses, and fittings for leaks.

(12) Check hose connections and pumps for security of attachment.

(13) Check electrical connectors on bypass solenoids for security of attachment and general condition.

ENGINE-DRIVEN HYDRAULIC PUMP CHECK VALVES - MAINTENANCE PRACTICES

1. General

A. Two check valves are provided in the lines from each engine-driven hydraulic pump. One valve is installed in the pressure line, the other is in the case drain line.

B. The valves are mounted to the pylon firewall with bulkhead fitting jamnuts.

C. Access to the valves is through an access door in the forward right apron of each inboard pylon.

D. The removal and installation procedures for the four engine-driven hydraulic pump check valves are identical.

2. Removal/Installation Engine-Driven Hydraulic Pump Check Valves

A. Remove Check Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect pump hose connected to inlet port of check valve.

(5) Unseat check valve poppet and drain line into a clean container.

(6) Disconnect hydraulic line connected to outlet port of check valve.

(7) Remove jamnut from outlet port of check valve and remove check valve.

B. Install Check Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Insert engine-driven hydraulic pump check valve into firewall and install jamnut. Flow arrow on check valve should point away from hydraulic pump.

(3) Connect hydraulic line to outlet port of check valve.

(4) Connect hydraulic pump hose to inlet port of check valve.

(5) Close auxiliary hydraulic pump control circuit breaker.

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ENGINE-DRIVEN HYDRAULIC PUMP CASE DRAIN FILTER - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pump case drain filters are located, one on each side of the airplane, on the aft side of the rear spar, opposite the leading edge of the inboard wing flaps.

B. Access to the filters is by lowering the wing flaps.

C. Removal/installation and inspection/check procedures for the left and right case drain filters are identical.

2. Removal/Installation Engine-Driven Hydraulic Pump Case Drain Filters

A. Remove Case Drain Filter

(1) Lower wing flaps for access to hydraulic pump case drain filters.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect hydraulic lines to inlet and outlet ports of filter.

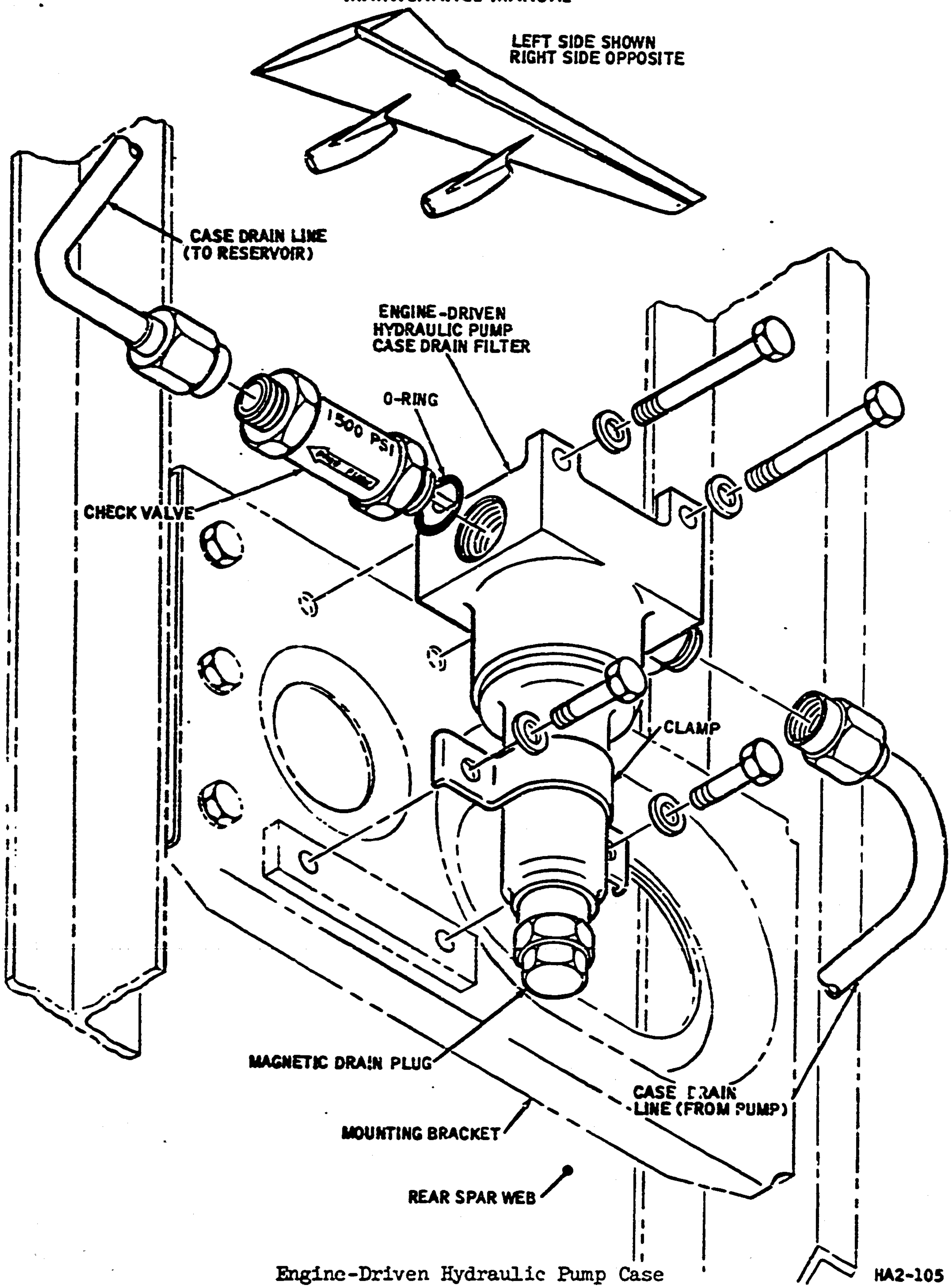
(5) Remove filter.

(6) Remove fitting and check valve from filter ports and retain for use in new unit. Discard O-rings.

B. Install Case Drain Filter

(1) Using new O-rings, install check valve in outlet port and fitting in inlet port.

(2) Fill filter case and filter element with clean hydraulic fluid.



Engine-Driven Hydraulic Pump Case
Drain Filter -- Installation
Figure 201

(3) Install filter.

(4) Connect hydraulic lines to inlet and outlet ports of filter.

3. Inspection/Check Engine-Driven Hydraulic Pump Case Drain Filter

A. Check Case Drain Filter

(1) Pressurize hydraulic system with engine-driven hydraulic pump(s), (see 29-00, Maintenance Practices).

(2) Visually check hydraulic pump case drain filter for general condition, security of attachment, and leaks.

(3) Shut down engine(s) (see Chapter 71); depressurize hydraulic system (see 29-00, Maintenance Practices).

(4) Remove magnetic drain plug from filter; check for metal particles.

(5) Install magnetic drain plug. Tighten plug to torque of 150 (±15) inch-pounds torque. Safety plug with lockwire.

ENGINE-DRIVEN HYDRAULIC PUMP CASE DRAIN FILTER ELEMENT - MAINTENANCE PRACTICES

1. General

A. The engine-driven hydraulic pump case drain filters are located, one on each side of the airplane, on the aft side of the rear spar, opposite the leading edge of the inboard wing flaps.

B. Access to the filters is by lowering the wing flaps.

C. Removal/installation procedures for the left and right case drain filter elements are identical.

2. Removal/Installation Engine-Driven Hydraulic Pump Case Drain Filter Elements

A. Remove Case Drain Filter Element

(1) Lower wing flaps for access to hydraulic pump case drain filters.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(2) Remove filter bowl from filter head.

(3) Remove filter element from filter head. Discard O-rings. Remove magnetic drain plug from filter bowl.

NOTE: To remove the filter element from the head, grasp the element firmly and gently rock from side to side while withdrawing the element from the filter head.

B. Install Case Drain Filter Element

(1) Install new O-rings in filter head and in filter element.

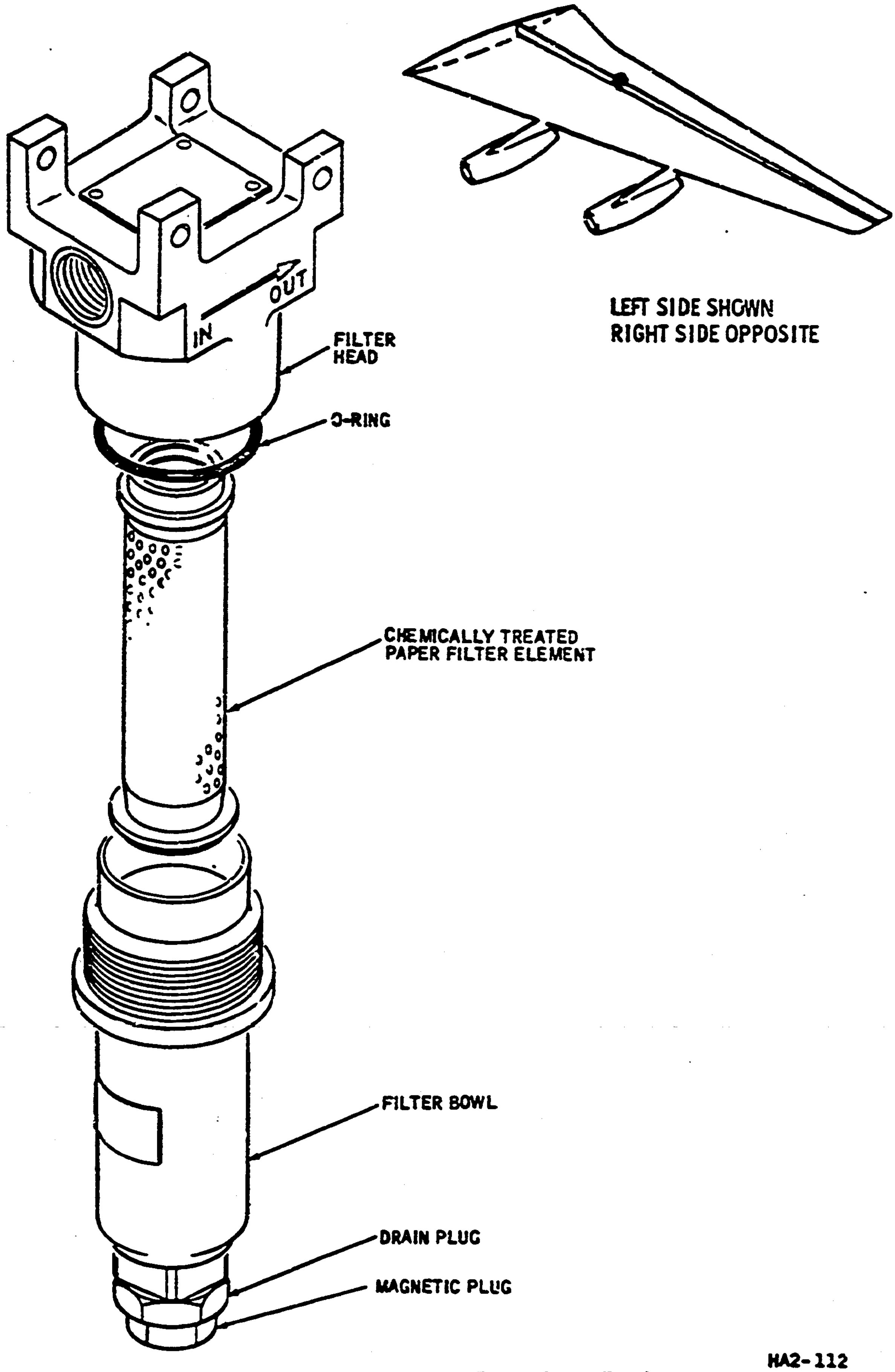
(2) Install filter element in filter head.

(3) Fill filter bowl with clean hydraulic fluid.

(4) Install filter bowl on filter head. Tighten bowl to torque of 120 to 180 inch-pounds.

(5) Install magnetic drain plug in bottom of filter bowl. Tighten plug to torque of 150 (±15) inch-pounds.

(6) Safety filter bowl and magnetic drain plug with lockwire.



Engine-Driven Hydraulic Pump Case Drain
Filter Element -- Installation
Figure 201

DUAL-FILTER AND RELIEF VALVE - MAINTENANCE PRACTICES

1. General

A. The dual-filter and relief valve is located in the left main gear wheel well on the lower portion of the wing rear spar, just outboard of the keel web.

B. Access to the dual-filter and relief valve is through the left main gear inboard door.

2. Removal/Installation Dual-Filter and Relief Valve

A. Remove Dual-Filter and Relief Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect lines from dual-filter and relief valve.

(5) Remove dual-filter and relief valve.

(6) Remove check valves and fitting from ports; retain for use in new unit. Discard O-rings.

B. Install Dual-Filter and Relief Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Using new O-rings, install check valves and fittings in dual-filter and relief valve ports.

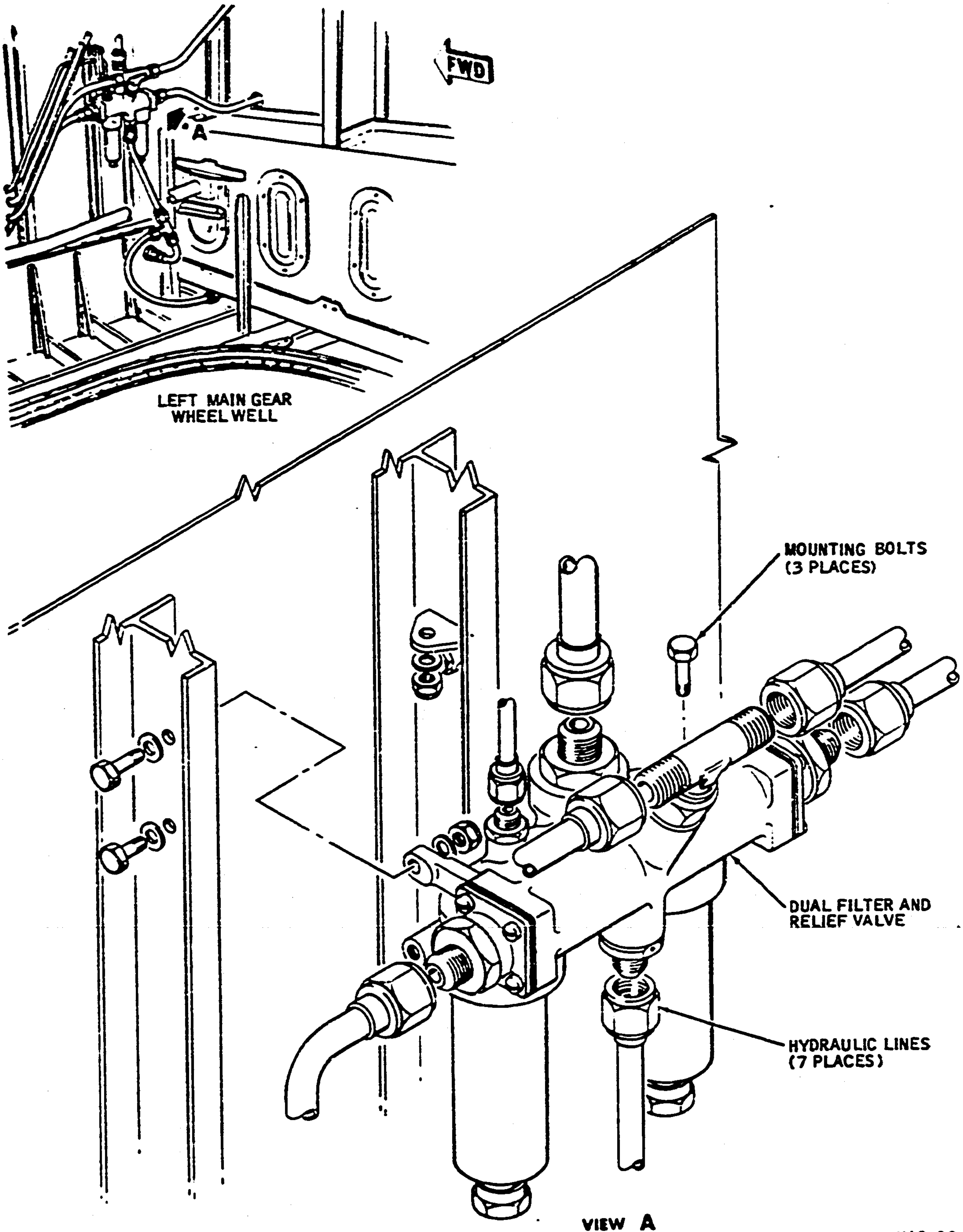
CAUTION: MAKE CERTAIN THAT THE FLOW ARROWS ON THE CHECK VALVES ARE POINTED IN THE PROPER DIRECTION.

(3) Install dual-filter and relief valve.

(4) Remove filter bowls from both sides of dual-filter and relief valve.

(5) Fill bowls with clean hydraulic fluid.

(6) Install bowls on dual-filter and relief valve.



Dual-Filter and Relief Valve -- Installation
Figure 201

(7) Tighten bowls to torque of 125 to 140 foot-pounds. Safety with lockwire.

(8) Connect lines to dual-filter and relief valve.

(9) Close auxiliary hydraulic pump control circuit breaker.

<u>CAUTION</u>: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINE.

3. <u>Inspection/Check Dual-Filter and Relief Valve</u>

A. Check Dual-Filter and Relief Valve

(1) Pressurize hydraulic system with test stand or engine-driven pump (see 29-00, Maintenance Practices).

(2) Check dual-filter and relief valve for leaks, general condition, and security of mounting.

(3) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(4) Remove magnetic drain plugs from bottom of filter sections of dual-filter and relief valve and check for metal particles.

(5) Install magnetic plugs. Tighten plugs to torque of 150 (±15) inch-pounds. Safety with lockwire.

(6) Depressurize hydraulic system (see 29-00, Maintenance Practices).

DUAL-FILTER AND RELIEF VALVE - MAINTENANCE PRACTICES

1. General

   A. The dual-filter and relief valve is located in the left main gear wheel well on the lower portion of the wing rear spar, just outboard of the keel web.

   B. Access to the dual-filter and relief valve is through the left main gear inboard door.

2. Removal/Installation Dual-Filter and Relief Valve

   A. Remove Dual-Filter and Relief Valve

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect lines from dual-filter and relief valve.

      (5) Remove dual-filter and relief valve.

      (6) Remove check valves and fitting from ports; retain for use in new unit. Discard O-rings.

   B. Install Dual-Filter and Relief Valve

      (1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

      (2) Using new O-rings, install check valves and fittings in dual-filter and relief valve ports.

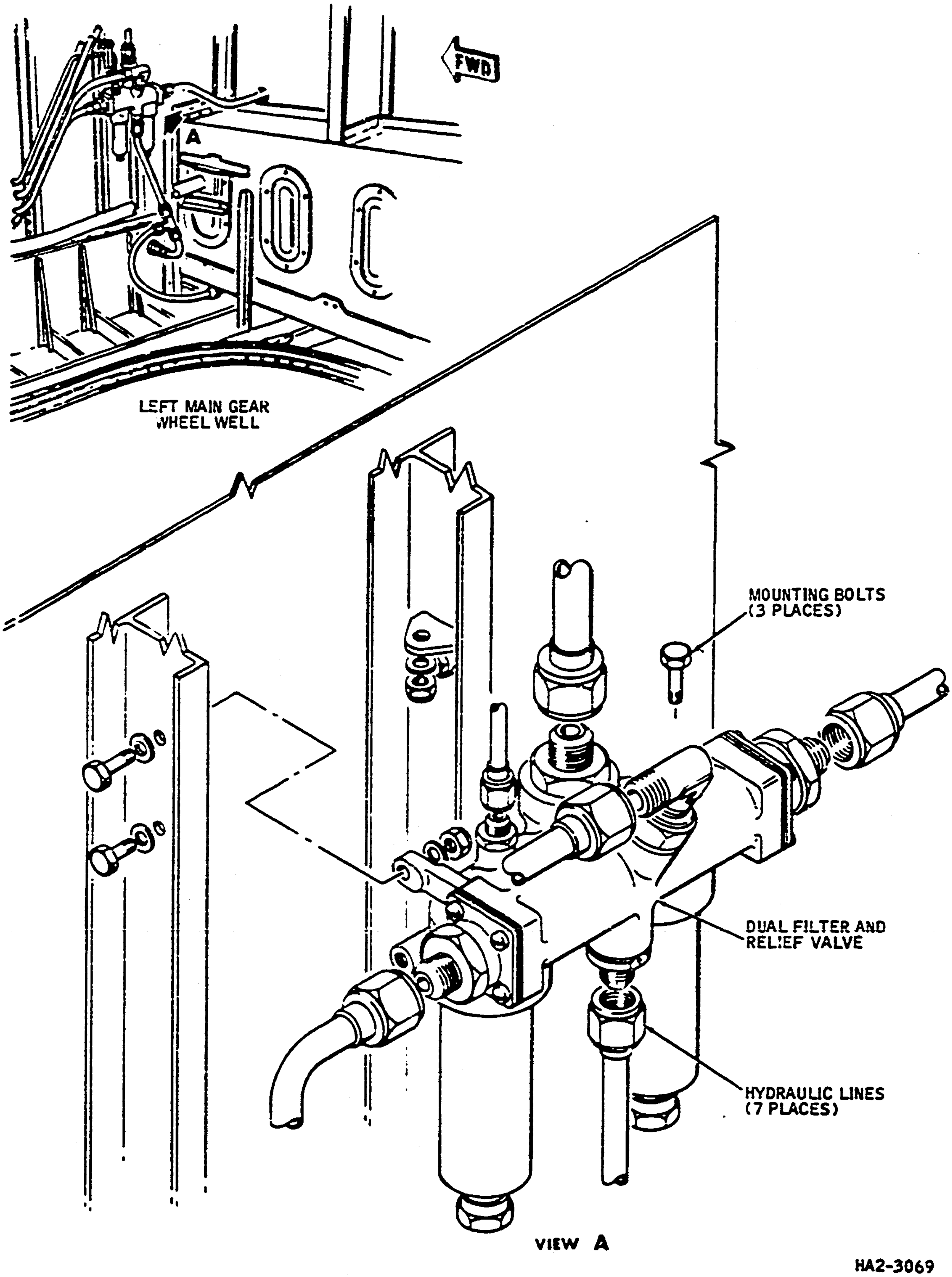
      CAUTION: MAKE CERTAIN THAT THE FLOW ARROWS ON THE CHECK VALVES ARE POINTED IN THE PROPER DIRECTION.

      (3) Install dual-filter and relief valve.

      (4) Remove filter bowls from both sides of dual-filter and relief valve.

      (5) Fill bowls with clean hydraulic fluid.

      (6) Install bowls on dual-dilter and relief valve.



Dual-Filter and Relief Valve -- Installation
Figure 201

(7) Tighten bowls to torque of 125 to 140 foot-pounds. Safety with lockwire.

(8) Connect lines to dual-filter and relief valve.

(9) Close auxiliary hydraulic pump control circuit breaker.

CAUTION: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINE.

3. Inspection/Check Dual-Filter and Relief Valve

A. Check Dual-Filter and Relief Valve

(1) Pressurize hydraulic system with test stand or engine-driven pump (see 29-00, Maintenance Practices).

(2) Check dual-filter and relief valve for leaks, general condition, and security of mounting.

(3) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(4) Remove magnetic drain plugs from bottom of filter sections of dual-filter and relief valve and check for metal particles.

(5) Install magnetic plugs. Tighten plugs to torque of 150 (±15) inch-pounds. Safety with lockwire.

(6) Depressurize hydraulic system (see 29-00, Maintenance Practices).

DUAL-FILTER ELEMENTS - MAINTENANCE PRACTICES

1. General

A. The dual-filter and relief valve is located in the left main gear wheel well on the lower portion of the wing rear spar, just outboard of the keel web.

B. Access to the dual-filter and relief valve is through the left main gear inboard door.

C. The ultrasonic method is recommended for cleaning filter elements.

D. Removal and installation procedures for both filter elements are identical.

2. Tools and Equipment Required

A. Varsol cleaning solvent (Federal Specification TT-T-291) is used for cleaning filter head, bowl, and magnetic drain plug.

3. Removal/Installation Dual Filter Elements

A. Remove Dual Filter Elements

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Relieve reservoir air pressure (see 29-00, Maintenance Practices).

(3) Remove magnetic drain plugs.

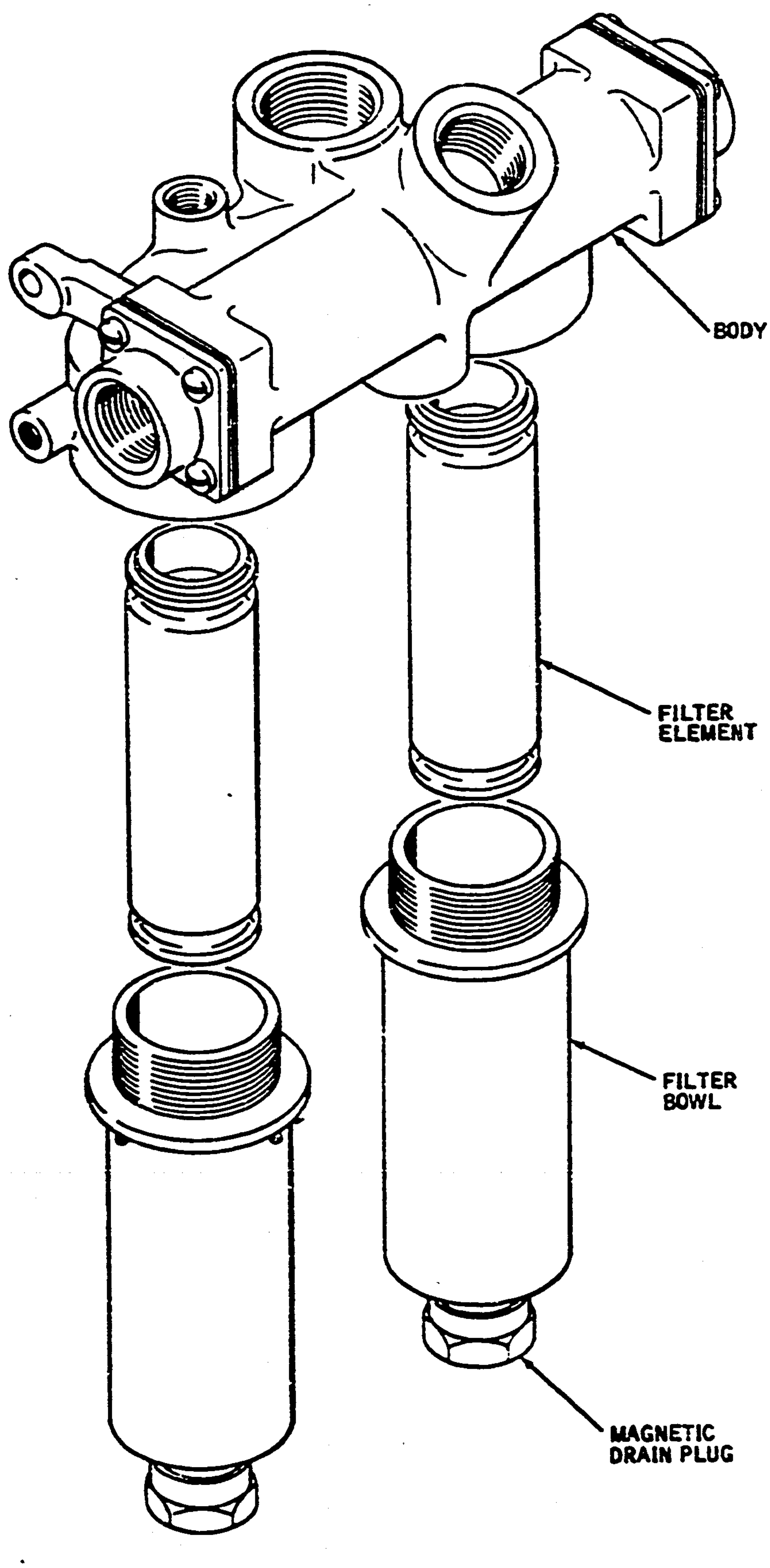
(4) Remove filter bowls and elements from dual-filter and relief valve.

(5) Cover filter ports.

(6) Wash filter bowls, filter heads, and magnetic drain plugs with clean Varsol (Federal Specification TT-T-291) and air-dry.

(7) Clean off any magnetic particles on magnetic drain plugs with clean, lint-free cloth.

CAUTION: PLACE MAGNETIC DRAIN PLUGS IN A CLEAN CONTAINER UNTIL READY FOR INSTALLATION.



Dual Filter Elements -- Installation
Figure 201

B. Install Dual-Filter Elements

(1) Remove cover from filter ports in dual-filter and relief valve.

(2) Using new O-rings, install filter elements.

(3) Fill filter bowls with clean hydraulic fluid.

(4) Using new O-rings, install filter bowls. Tighten bowls to torque of 125 to 140 foot-pounds and safety with lockwire.

(5) Using new O-rings, install magnetic drain plugs. Tighten plugs to torque of 150 (±15) inch-pounds and safety with lockwire.

4. Inspection/Check Dual-Filter Elements

A. Check Dual-Filter Elements

(1) Pressurize hydraulic system with test stand or engine-driven pump (see 29-00, Maintenance Practices).

(2) Check dual-filter and relief valve for leaks around filter bowls and magnetic drain plugs.

(3) Check filter bowls and magnetic drain plugs for proper installation of lockwire.

SYSTEM SELECTOR VALVE - MAINTENANCE PRACTICES

1. General

A. The system selector valve is mounted on the left power manifold which is located overhead in the forward inboard corner of the left main gear wheel well.

B. Access to the system selector valve is through the left main gear inboard door.

2. Removal/Installation System Selector Valve

A. Remove System Selector Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect pushrod from operating crank of system selector valve.

(5) Disconnect engine pump pressure line.

(6) Disconnect auxiliary pump pressure line.

(7) Disconnect auxiliary pump alternate pressure line.

(8) Remove system selector valve from manifold. Discard O-rings. Cover manifold mounting pad to prevent entrance of foreign material.

(9) Remove fittings from valve and retain for use in new unit. Discard O-rings.

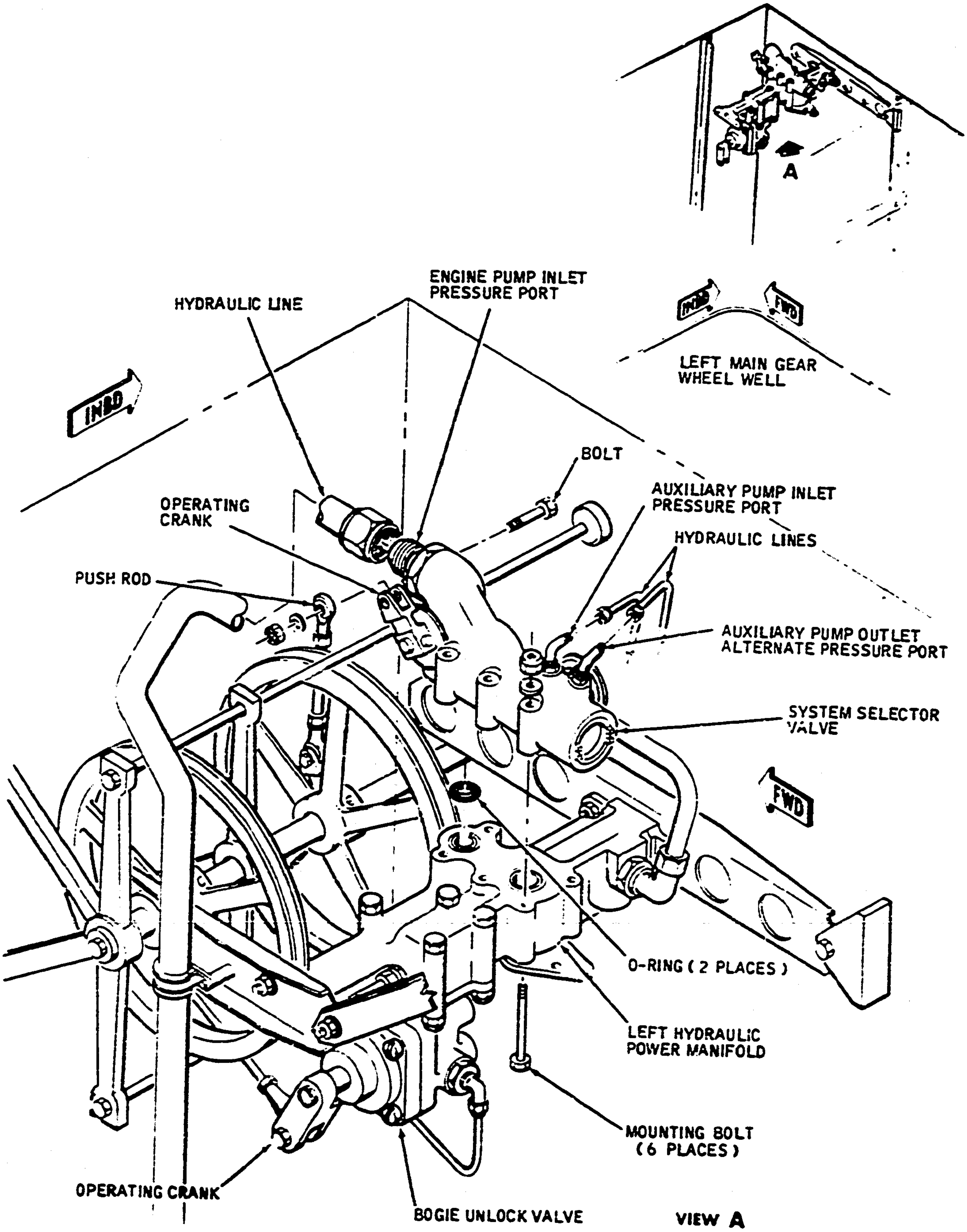
B. Install System Selector Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Using new O-rings, install fittings in valve ports.

(3) Install new O-rings at pressure and return ports in manifold.

(4) Install system selector valve on manifold. Tighten mounting bolts to torque of 140 inch-pounds.



System Selector Valve -- Installation
Figure 201

(5) Connect auxiliary pump alternate pressure line.

(6) Connect auxiliary pump pressure line.

(7) Connect engine pump pressure line.

(8) Close auxiliary hydraulic pump control circuit breaker.

(9) Perform system selector valve adjustment/test procedures (see Paragraph 3).

<u>CAUTION</u>: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

<u>Adjustment/Test System Selector Valve</u>

A. Adjust System Selector Valve

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Disconnect pushrod from operating crank.

(3) Manually position operating crank of selector valve so that it is pointing forward (bypass position), (see 29-10-0, Adjustment/Test, Figure 501).

(4) Pressurize hydraulic system with test stand at low flow rate (see 29-00, Maintenance Practices).

<u>WARNING</u>: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Rotate selector valve operating crank aft to a position where flow through system selector valve just stops.

<u>NOTE</u>: Bypass flow stoppage is detectable by monentary increase in pressure indication on system pressure accumulator gage.

(6) Adjust system selector valve pushrod so that bolt can be easily inserted through operating crank and rod end of pushrod.

(7) Lengthen system selector valve pushrod 7/32 inch by rotating each end of pushrod three turns counterclockwise.

(8) Connect pushrod to operating crank of system selector valve.

(9) Depressurize hydraulic system (see 29-00).

4. Inspection/Check System Selector Valve

A. Check System Selector Valve

NOTE: The system selector valve may be difficult to move in the bypass/general system (number 1) position. This is normal and due to a hydraulic snubber action inside the valve.

(1) Check freedom of movement of control system by operating hydraulic system selector control lever several times through full operating travel.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Pressurize hydraulic system with external source (test stand) to full system pressure (3000 psi) (see 29-00, Maintenance Practices). Hydraulic system pressure indicator in flight compartment should indicate approximately 3000 psi.

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR LOCKPINS ARE INSTALLED.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Place hydraulic system selector control lever in bypass/general system position.

(6) Pressurize hydraulic system with external source (test stand) to full system pressure. Hydraulic system pressure indicator in flight compartment should remain at zero psi.

(7) Depressurize hydraulic system.

(8) Place hydraulic system selector control lever in general system/main gear downlock and flaps position.

(9) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(10) Hydraulic system pressure indicator in flight compartment should indicate zero psi.

(11) Cycle wing flaps several times. If wing flaps operate properly, system selector valve is porting fluid to flaps and main gear downlock cylinders.

(12) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(13) Place hydraulic system selector control lever in general system (normal) position.

(14) Check system selector valve and fittings for leaks, general condition, and security of attachment.

(15) Check selector valve pushrod to operating crank and pushrod to sector connections for proper installation and security.

SYSTEM SELECTOR VALVE - MAINTENANCE PRACTICES

1. General

A. The system selector valve is mounted on the left power manifold which is located overhead in the forward inboard corner of the left main gear wheel well.

B. Access to the system selector valve is through the left main gear inboard door.

2. Removal/Installation System Selector Valve

A. Remove System Selector Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect pushrod from operating crank of system selector valve.

(5) Disconnect engine pump pressure line.

(6) Disconnect auxiliary pump pressure line.

(7) Disconnect auxiliary pump alternate pressure line.

(8) Remove system selector valve from manifold. Discard O-rings. Cover manifold mounting pad to prevent entrance of foreign material.

(9) Remove fittings from valve and retain for use in new unit. Discard O-rings.

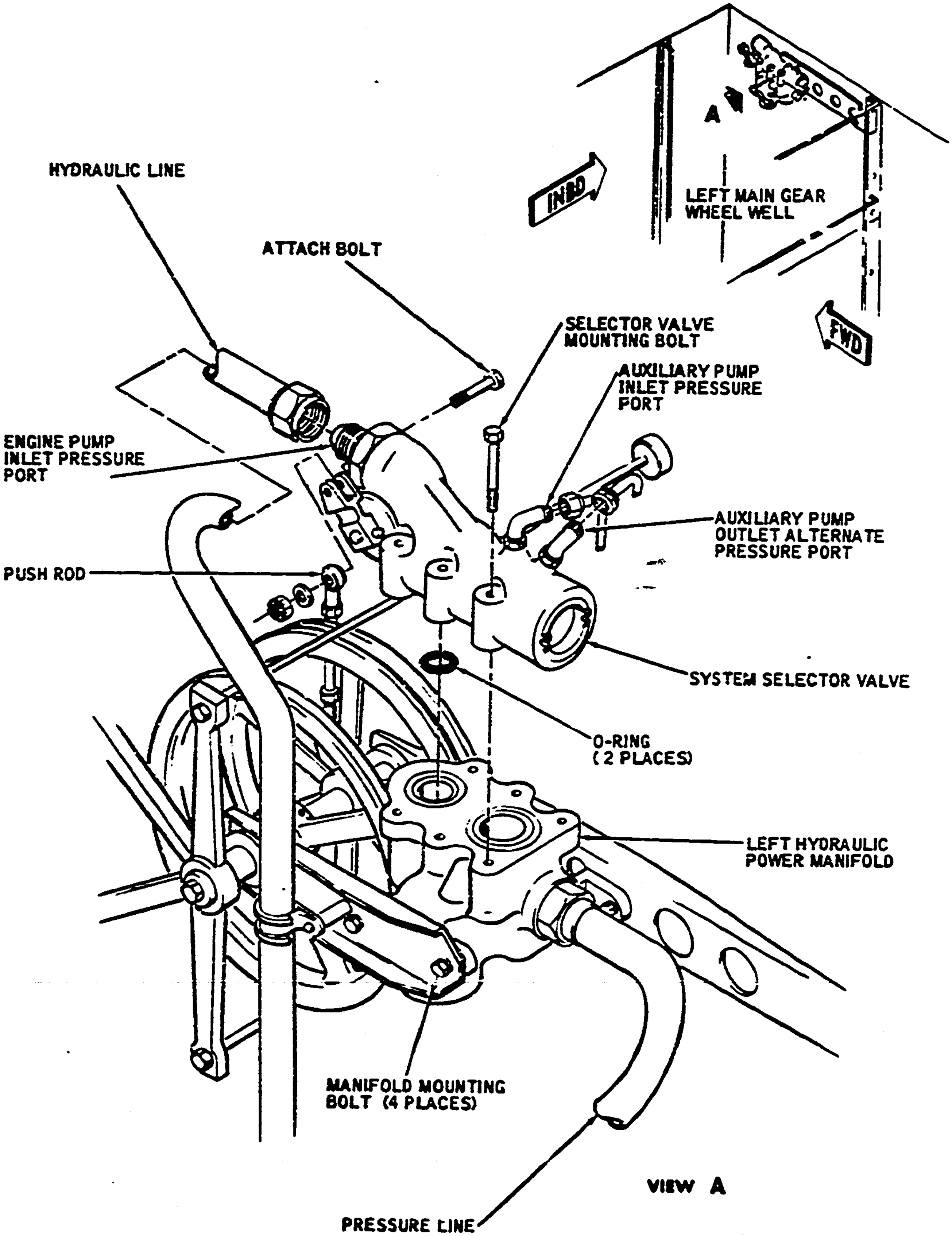
B. Install System Selector Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Using new O-rings, install fittings in valve ports.

(3) Install new O-rings at pressure and return ports in manifold.

(4) Install system selector valve on manifold. Tighten mounting bolts to torque of 140 inch-pounds.



System Selector Valve -- Installation
Figure 201

(5) Connect auxiliary pump alternate pressure line.

(6) Connect auxiliary pump pressure line.

(7) Connect engine pump pressure line.

(8) Close auxiliary hydraulic pump control circuit breaker.

(9) Perform system selector valve adjustment/test procedures (see Paragraph 3).

<u>CAUTION</u>: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

<u>Adjustment/Test System Selector Valve</u>

A. Adjust System Selector Valve

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Disconnect pushrod from operating crank.

(3) Manually position operating crank of selector valve so that it is pointing forward (bypass position), (see 29-10-0, Adjustment/Test, Figure 501).

(4) Pressurize hydraulic system with test stand at low flow rate (see 29-00, Maintenance Practices).

<u>WARNING</u>: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Rotate selector valve operating crank aft to a position where flow through system selector valve just stops.

<u>NOTE</u>: Bypass flow stoppage is detectable by momentary increase in pressure indication on system pressure accumulator gage.

(6) Adjust system selector valve pushrod so that bolt can be easily inserted through operating crank and rod end of pushrod.

(7) Lengthen system selector valve pushrod 7/32 inch by rotating each end of pushrod three turns counterclockwise.

(8) Connect pushrod to operating crank of system selector valve.

(9) Depressurize hydraulic system (see 29-00).

4. Inspection/Check System Selector Valve

A. Check System Selector Valve

NOTE: The system selector valve may be difficult to move in the bypass/general system (number 1) position. This is normal and due to a hydraulic snubber action inside the valve.

(1) Check freedom of movement of control system by operating hydraulic system selector control lever several times through full operating travel.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Pressurize hydraulic system with external source (test stand) to full system pressure (3000 psi) (see 29-00, Maintenance Practices). Hydraulic system pressure indicator in flight compartment should indicate approximately 3000 psi.

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR LOCKPINS ARE INSTALLED.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Place hydraulic system selector control lever in bypass/general system position.

(6) Pressurize hydraulic system with external source (test stand) to full system pressure. Hydraulic system pressure indicator in flight compartment should remain at zero psi.

(7) Depressurize hydraulic system.

(8) Place hydraulic system selector control lever in general system/main gear downlock and flaps position.

(9) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(10) Hydraulic system pressure indicator in flight compartment should indicate zero psi.

(11) Cycle wing flaps several times. If wing flaps operate properly, system selector valve is porting fluid to flaps and main gear downlock cylinders.

(12) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(13) Place hydraulic system selector control lever in general system (normal) position.

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(14) Check system selector valve and fittings for leaks, general condition, and security of attachment.

(15) Check selector valve pushrod to operating crank and pushrod to sector connections for proper installation and security.

SYSTEM SELECTOR VALVE - MAINTENANCE PRACTICES

1. General

   A. The system selector valve is mounted on the left power manifold which is located overhead in the forward inboard corner of the left main gear wheel well.

   B. Access to the system selector valve is through the left main gear inboard door.

2. Removal/Installation System Selector Valve

   A. Remove System Selector Valve

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect pushrod from operating crank of system selector valve.

      (5) Disconnect engine pump pressure line.

      (6) Disconnect auxiliary pump pressure line.

      (7) Disconnect auxiliary pump alternate pressure line.

      (8) Remove system selector valve from manifold. Discard O-rings. Cover manifold mounting pad to prevent entrance of foreign material.

      (9) Remove fittings from valve and retain for use in new unit. Discard O-rings.

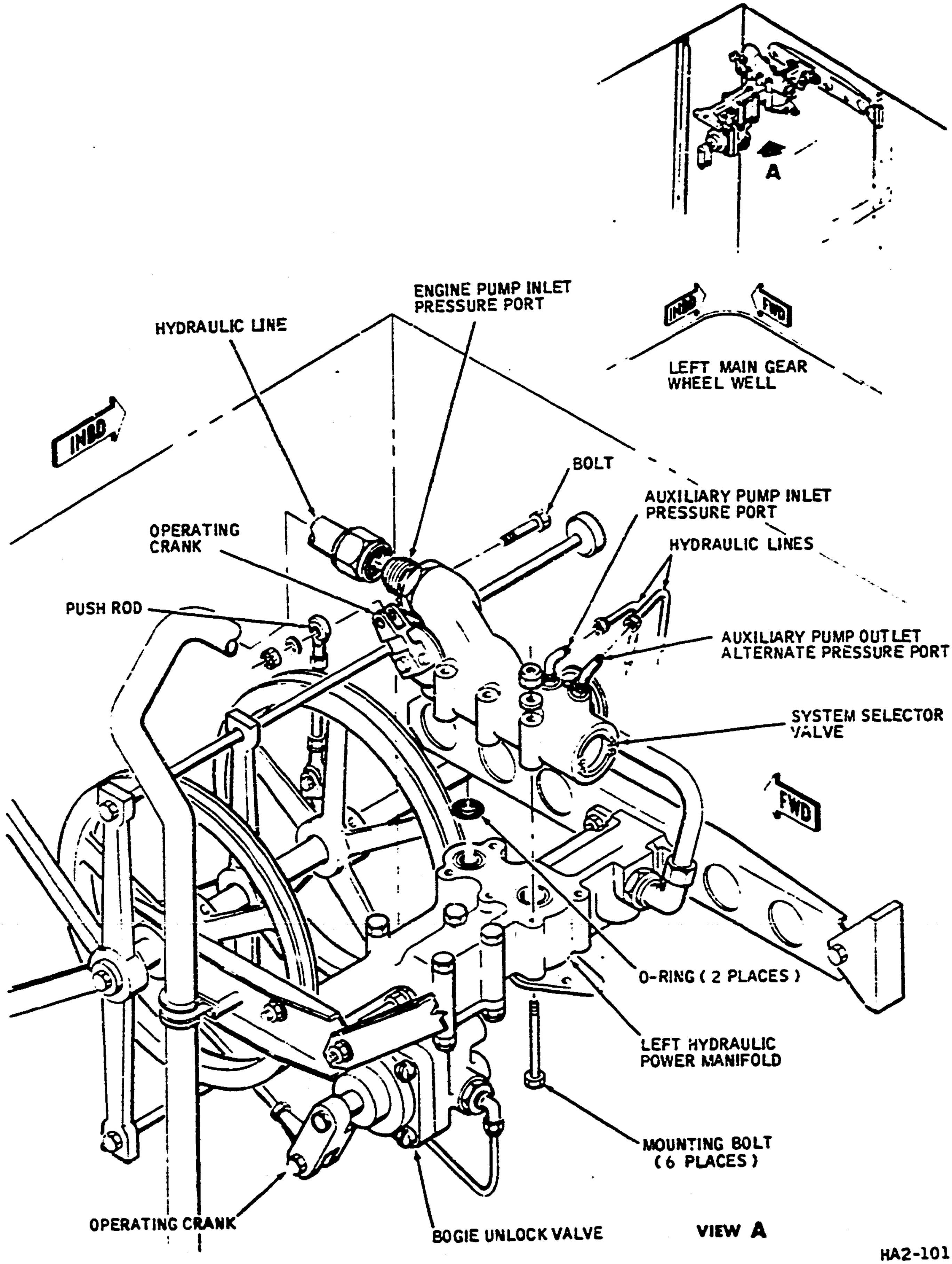
   B. Install System Selector Valve

      (1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

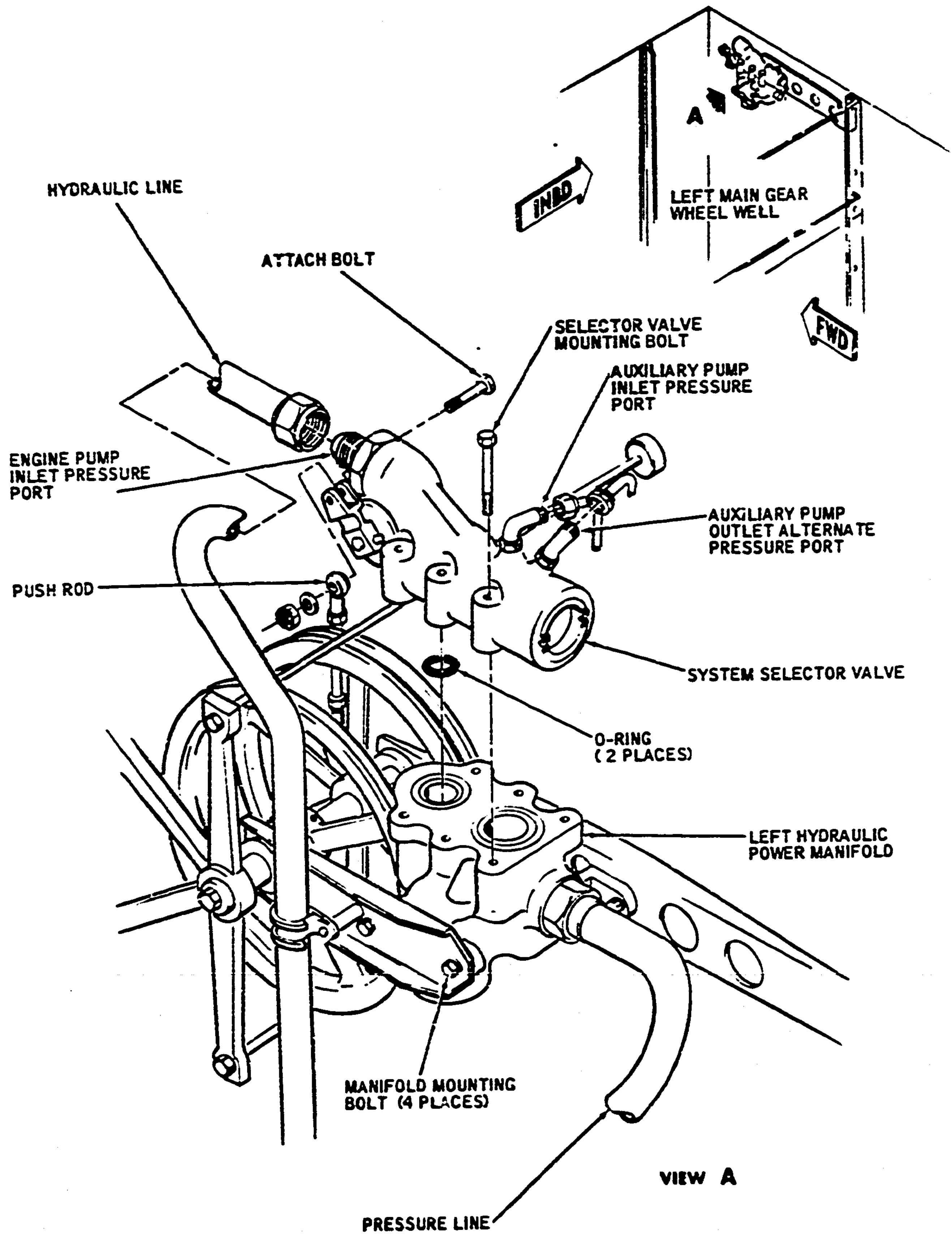
      (2) Using new O-rings, install fittings in valve ports.

      (3) Install new O-rings at pressure and return ports in manifold.

      (4) Install system selector valve on manifold. Tighten mounting bolts to torque of 140 inch-pounds.



System Selector Valve -- Installation
(Airplanes 801-822, 860-866)
Figure 201 (Sheet 1)



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System Selector Valve -- Installation
(Airplanes 867 and Subsequent)
Figure 201 (Sheet 2)

(5) Connect auxiliary pump alternate pressure line.

(6) Connect auxiliary pump pressure line.

(7) Connect engine pump pressure line.

(8) Close auxiliary hydraulic pump control circuit breaker.

(9) Perform system selector valve adjustment/test procedures (see Paragraph 3).

CAUTION: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

3. Adjustment/Test System Selector Valve

A. Adjust System Selector Valve

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Disconnect pushrod from operating crank.

(3) Manually position operating crank of selector valve so that it is pointing forward (bypass position), (see 29-10-0, Adjustment/Test, Figure 501).

(4) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Rotate selector valve operating crank aft to a position where flow through system selector valve just stops.

NOTE: Bypass flow stoppage is detectable by momentary increase in pressure indication on system pressure accumulator gage.

(6) Adjust system selector valve pushrod so that bolt can be easily inserted through operating crank and rod end of the pushrod.

(7) Lengthen system selector valve pushrod 7/32 inch by rotating each end of pushrod three turns counterclockwise.

(8) Connect pushrod to operating crank of system selector valve.

(9) Depressurize hydraulic system (see 29-00).

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4. Inspection/Check System Selector Valve

A. Check System Selector Valve

NOTE: The system selector valve may be difficult to move in the bypass/general system (number 1) position. This is normal and due to a hydraulic snubber action inside the valve.

(1) Check freedom of movement of control system by operating hydraulic system selector control lever several times through full operating travel.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Pressurize hydraulic system with external source (test stand) to full system pressure (3000 psi) (see 29-00, Maintenance Practices). Hydraulic system pressure indicator in flight compartment should indicate approximately 3000 psi.

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR LOCKPINS ARE INSTALLED.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Place hydraulic system selector control lever in bypass/general system position.

(6) Pressurize hydraulic system with external source (test stand) to full system pressure. Hydraulic system pressure indicator in flight compartment should remain at zero psi.

(7) Depressurize hydraulic system.

(8) Place hydraulic system selector control lever in general system/flaps only position.

(9) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(10) Hydraulic system pressure indicator in flight compartment should indicate zero psi.

(11) Cycle wing flaps several times. If wing flaps operate properly, system selector valve is porting fluid to flaps.

(12) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(13) Place hydraulic system selector control lever in general system (normal) position.

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(14) Check system selector valve and fittings for leaks, general condition, and security of attachment.

(15) Check selector valve pushrod to operating crank and pushrod to sector connections for proper installation and security.

SYSTEM SELECTOR VALVE - MAINTENANCE PRACTICES

1. General

A. The system selector valve is mounted on the left power manifold which is located overhead in the forward inboard corner of the left main gear wheel well.

B. Access to the system selector valve is through the left main gear inboard door.

2. Removal/Installation System Selector Valve

A. Remove System Selector Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect pushrod from operating crank of system selector valve.

(5) Disconnect engine pump pressure line.

(6) Disconnect auxiliary pump pressure line.

(7) Disconnect auxiliary pump alternate pressure line.

(8) Remove system selector valve from manifold. Discard O-rings. Cover manifold mounting pad to prevent entrance of foreign material.

(9) Remove fittings from valve and retain for use in new unit. Discard O-rings.

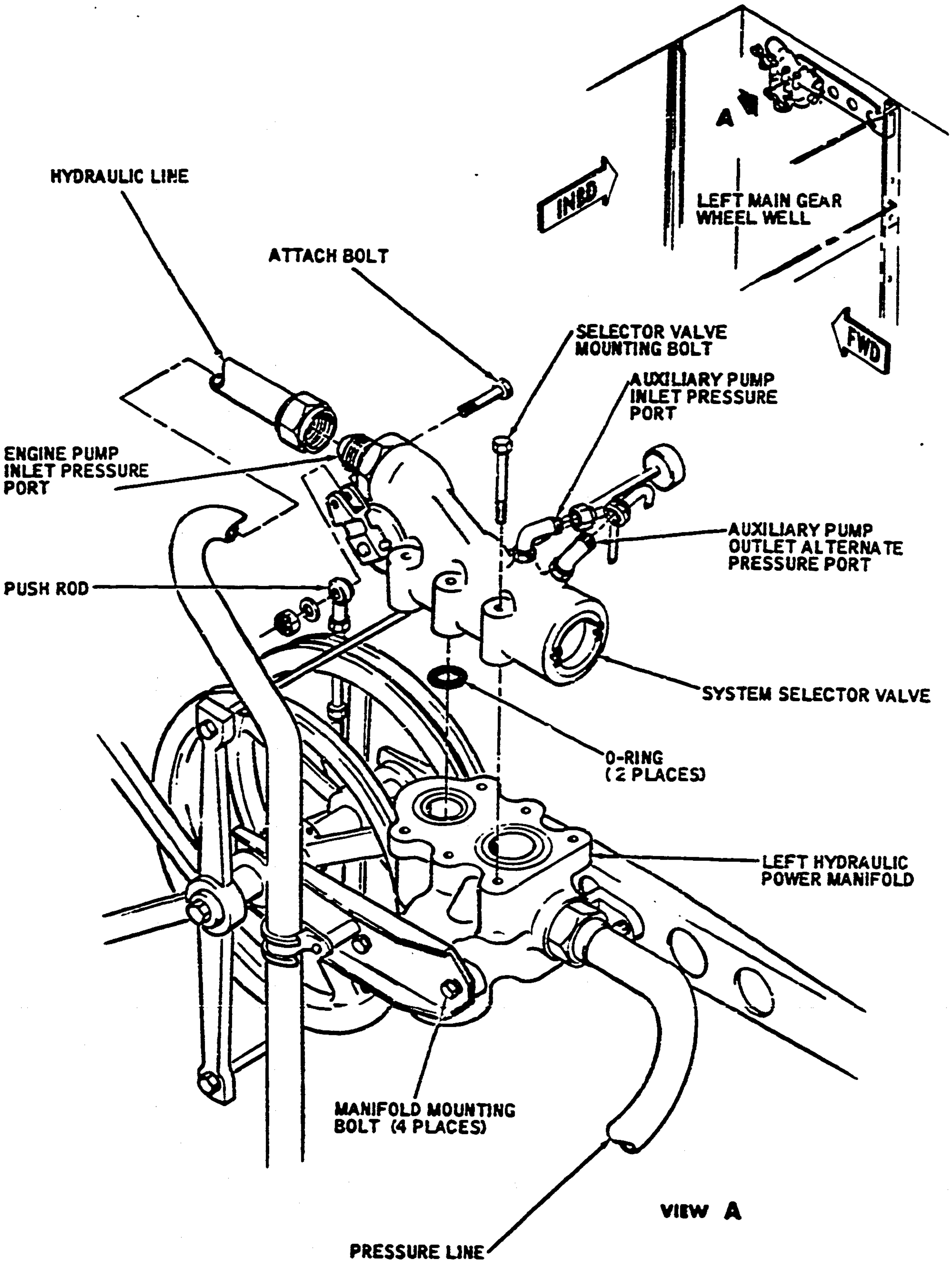
B. Install System Selector Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Using new O-rings, install fittings in valve ports.

(3) Install new O-rings at pressure and return ports in manifold.

(4) Install system selector valve on manifold. Tighten mounting bolts to torque of 140 inch-pounds.



System Selector Valve -- Installation
Figure 201

(5) Connect auxiliary pump alternate pressure line.

(6) Connect auxiliary pump pressure line.

(7) Connect engine pump pressure line.

(8) Close auxiliary hydraulic pump control circuit breaker.

(9) Perform system selector valve adjustment/test procedures (see Paragraph 3).

CAUTION: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

3. Adjustment/Test System Selector Valve

A. Adjust System Selector Valve

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Disconnect pushrod from operating crank.

(3) Manually position operating crank of selector valve so that it is pointing forward (bypass position), (see 29-10-0, Adjustment/Test, Figure 501).

(4) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(5) Rotate selector valve operating crank aft to a position where flow through system selector valve just stops.

NOTE: Bypass flow stoppage is detectable by momentary increase in pressure indication on system pressure accumulator gage.

(6) Adjust system selector valve pushrod so that bolt can be easily inserted through operating crank and rod end of pushrod.

(7) Lengthen system selector valve pushrod 7/32 inch by rotating each end of pushrod three turns counterclockwise.

(8) Connect pushrod to operating crank of system selector valve.

(9) Depressurize hydraulic system (see 29-00).

4. Inspection/Check System Selector Valve

A. Check System Selector Valve

NOTE: The system selector valve may be difficult to move in the bypass/general system (number 1) position. This is normal and due to a hydraulic snubber inside the valve.

(1) Check freedom of movement of control system by operating hydraulic system selector control lever several times through full operating travel.

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Pressurize hydraulic system with external source (test stand) to full system pressure (3000 psi) (see 29-00, Maintenance Practices). Hydraulic system pressure indicator in flight compartment should indicate approximately 3000 psi.

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR LOCKPINS ARE INSTALLED.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Place hydraulic system selector control lever in bypass/general system position.

(6) Pressurize hydraulic system with external source (test stand) to full system pressure. Hydraulic system pressure indicator in flight compartment should remain at zero psi.

(7) Depressurize hydraulic system.

(8) Place hydraulic system selector control lever in general system/flaps only position.

(9) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(10) Hydraulic system pressure indicator in flight compartment should indicate zero psi.

(11) Cycle wing flaps several times. If wing flaps operate properly, system selector valve is porting fluid to flaps.

(12) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(13) Place hydraulic system selector control lever in general system (normal) position.

(14) Check system selector valve and fittings for leaks, general condition, and security of attachment.

(15) Check selector valve pushrod to operating crank and pushrod to sector connections for proper installation and security.

LEFT HYDRAULIC POWER MANIFOLD - MAINTENANCE PRACTICES

1. General

   A. The left hydraulic power manifold is located overhead in the forward inboard corner of the left main gear wheel well.

   B. Access to the left power manifold is through the left main gear inboard door.

2. Removal/Installation Left Hydraulic Power Manifold

   A. Remove Left Power Manifold

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect pushrods from operating cranks of system selector valve and bogie swivel unlock valve.

      (5) Disconnect hydraulic lines from bogie unlock valve, system selector valve, and power manifold.

      (6) Remove priority valve from manifold (see 29-10-23).

      (7) Remove bogie unlock valve from manifold (see Chapter 32).

      (8) Remove system selector valve from manifold (see 29-10-18).

      (9) Remove left hydraulic power manifold.

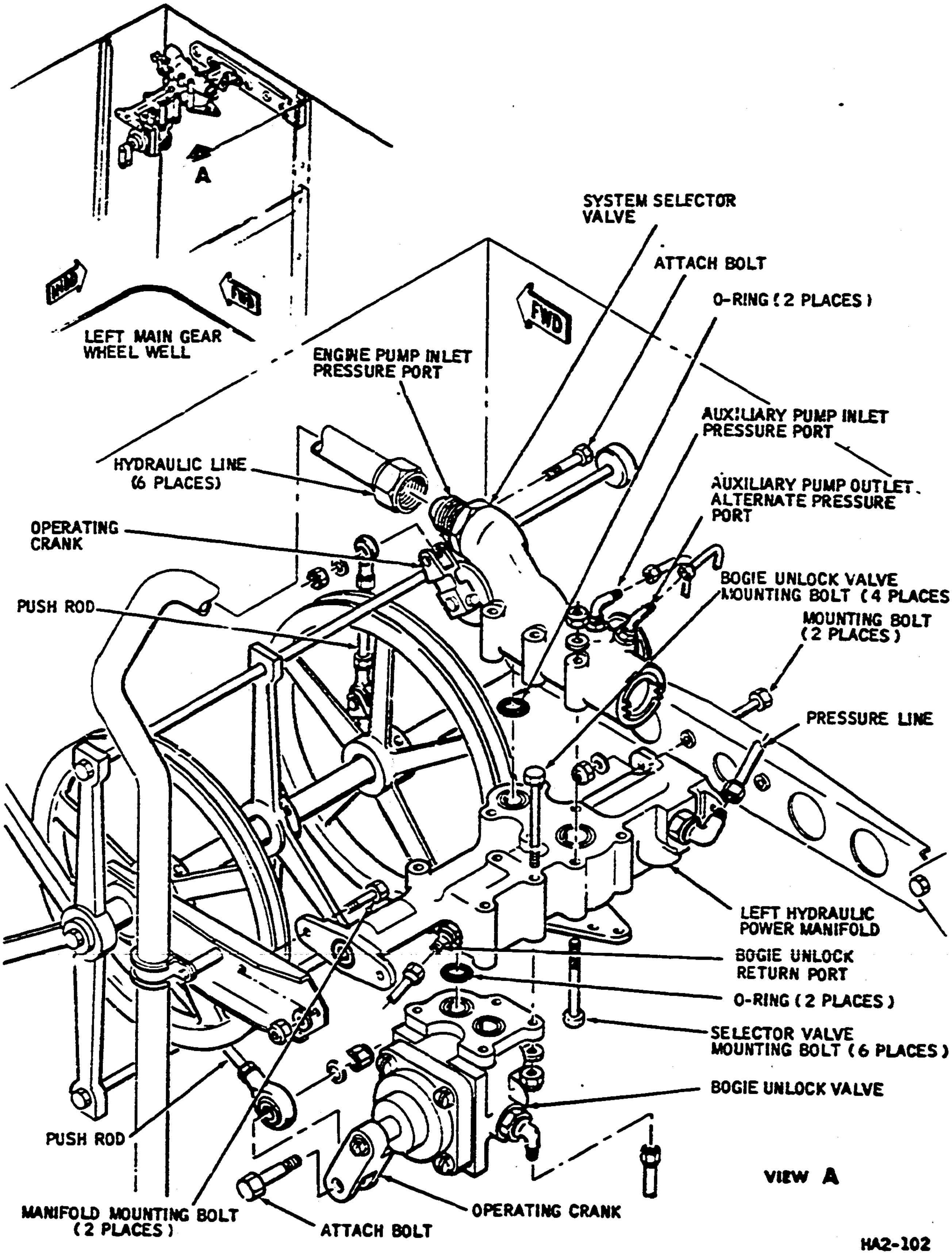
   B. Install Left Power Manifold

      (1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

      (2) Install left power manifold on its support.

      (3) Install system selector valve on manifold (see 29-10-18).

      (4) Install bogie unlock valve on manifold (see Chapter 32).



Left Hydraulic Power Manifold -- Installation
Figure 201

(5) Install priority valve on manifold (see 29-10-23).

(6) Connect hydraulic lines to system selector valve, bogie unlock valve, and power manifold.

(7) Connect pushrod to operating crank of system selector valve and adjust as necessary (see 29-10-18).

(8) Connect pushrod to bogie swivel unlock valve and adjust as necessary (see Chapter 32).

(9) Close auxiliary hydraulic pump control circuit breaker.

CAUTION: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

3. Inspection/Check Left Hydraulic Power Manifold

A. Check Left power Manifold

(1) Check system selector valve (see 29-10-18).

(2) Check bogie swivel unlock valve (see Chapter 32).

(3) Check priority valve (see 29-10-23).

(4) Check system selector valve, bogie swivel unlock valve, and priority valve for security of attachment and leaks.

(5) Check hydraulic lines for security of attachment, general condition, clearance, and leaks.

LEFT HYDRAULIC POWER MANIFOLD - MAINTENANCE PRACTICES

1. General

   A. The left hydraulic power manifold is located overhead in the forward inboard corner of the left main gear wheel well.

   B. Access to the left power manifold is through the left main gear inboard door.

2. Removal/Installation Left Hydraulic Power Manifold

   A. Remove Left Power Manifold

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect pushrod from operating crank of system selector valve.

      (5) Disconnect hydraulic lines from system selector valve and power manifold.

      (6) Remove priority valve from manifold (see 29-10-23).

      (7) Remove system selector valve from manifold (see 29-10-18).

      (8) Remove left hydraulic power manifold.

   B. Install Left Power Manifold

      (1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

      (2) Install left power manifold on its support.

      (3) Install system selector valve on manifold (see 29-10-18).

      (4) Install priority valve on manifold (see 29-10-23).

      (5) Connect hydraulic lines to system selector valve and power manifold.

      (6) Connect pushrod to operating crank of system selector valve and adjust as necessary (see 29-10-18).

      (7) Close auxiliary hydraulic pump control circuit breaker.

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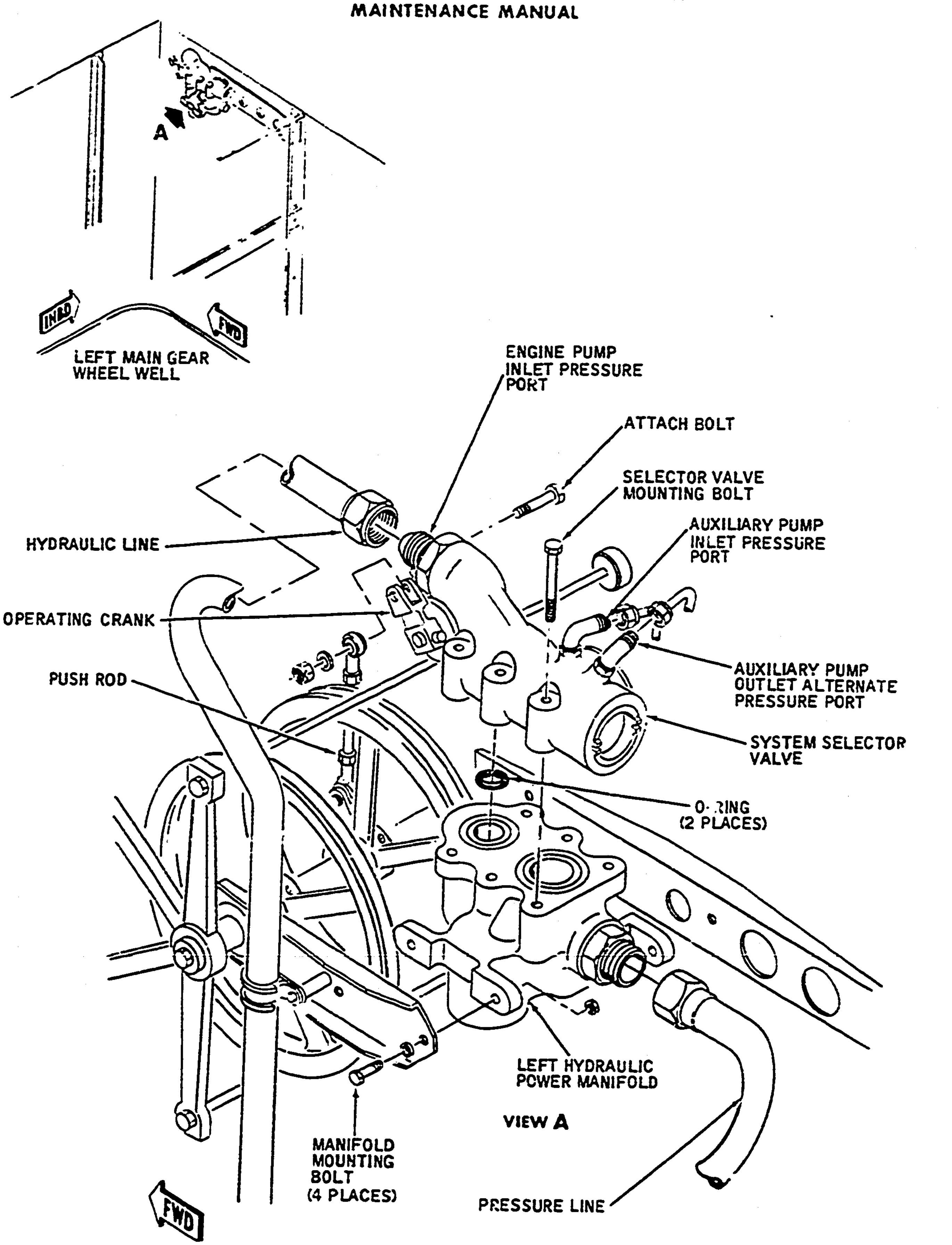

Left Hydraulic Power Manifold -- Installation
Figure 201

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CAUTION: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

3. Inspection/Check Left Hydraulic Power Manifold

A. Check Left Power Manifold

(1) Check system selector valve (see 29-10-18).

(2) Check priority valve (see 29-10-23).

(3) Check system selector valve and priority valve for security of attachment and leaks.

(4) Check hydraulic lines for security of attachment, general condition, clearance, and leaks.

(5) Check left power manifold for security of attachment and leaks.

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LEFT HYDRAULIC POWER MANIFOLD - MAINTENANCE PRACTICES

1. General

A. The left hydraulic power manifold is located overhead in the forward inboard corner of the left main gear wheel well.

B. Access to the left power manifold is through the left main gear inboard door.

2. Removal/Installation Left Hydraulic Power Manifold

A. Remove Left Power Manifold

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) On airplanes 801-811, relieve air pressure from emergency air ejector supply bottle (see Chapter 20).

(5) On airplanes 801-811, disconnect pushrods from operating cranks of system selector valve, bogie swivel unlock valve, and emergency air ejector control valve.

(6) Disconnect hydraulic lines from bogie unlock valve, system selector valve, priority valve, and power manifold.

(7) On airplanes 801-811, disconnect air lines from emergency air ejector control valve.

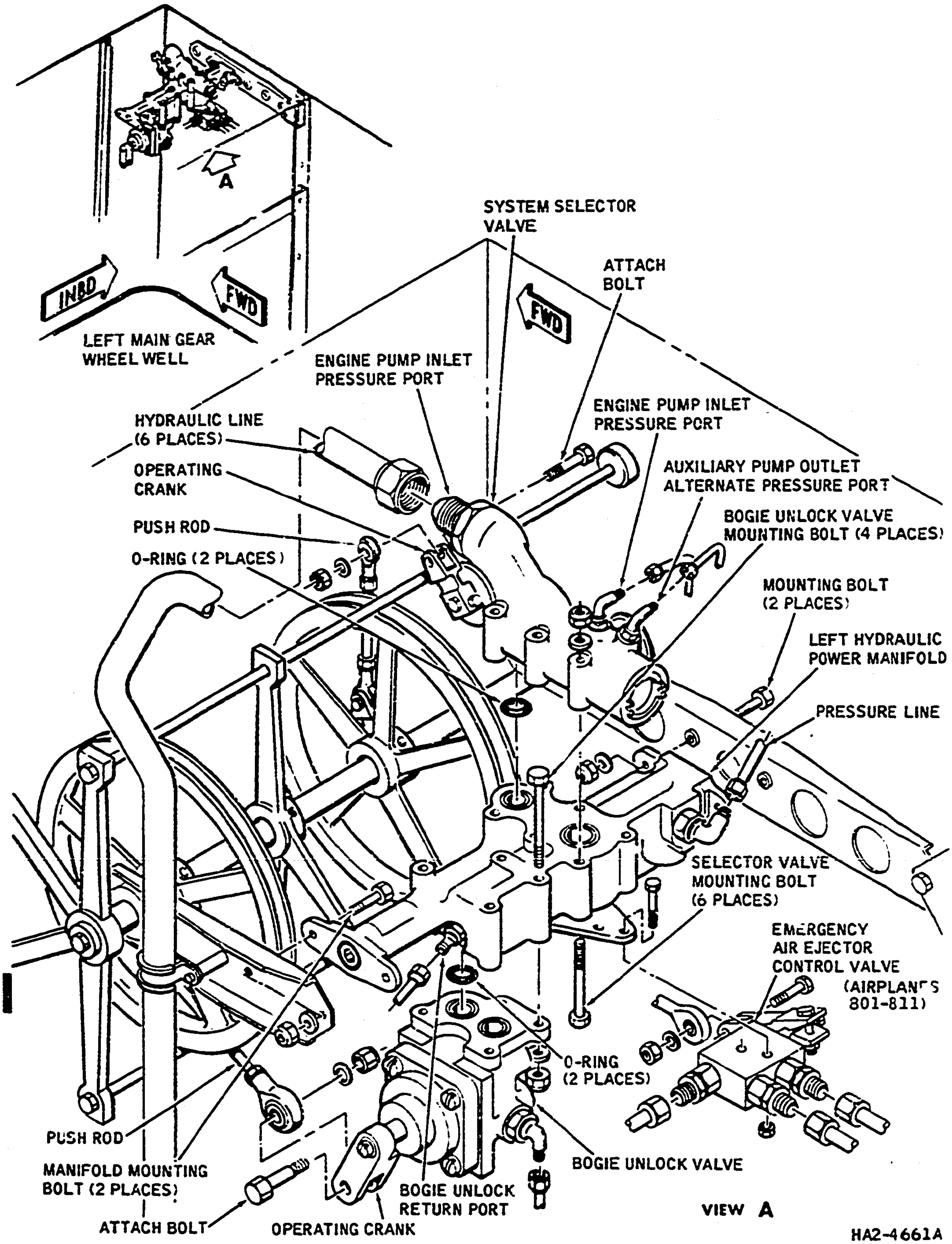
(8) Remove priority valve from manifold (see 29-10-23).

(9) Remove bogie unlock valve from manifold (see Chapter 32).

(10) On airplanes 801-811, remove emergency air ejector control valve from manifold.

(11) Remove system selector valve from manifold (see 29-10-18).

(12) Remove left hydraulic power manifold.



Left Hydraulic Power Manifold -- Installation
Figure 201

B. Install Left Power Manifold

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Install left power manifold on its support.

(3) Install system selector valve on manifold (see 29-10-18).

(4) Install emergency air ejector control valve on manifold.

(5) Install bogie unlock valve on manifold (see Chapter 32).

(6) Install priority valve on manifold (see 29-10-23).

(7) Connect air lines to emergency air ejector control valve on airplanes 801-811.

(8) Connect hydraulic lines to system selector valve, bogie unlock valve, priority valve, and power mainfold.

(9) Connect pushrod to operating crank of system selector valve and adjust as necessary (see 29-10-18).

(10) Connect pushrod to bogie swivel unlock valve and adjust as necessary (see Chapter 32).

(11) Connect pushrod to emergency air ejector control valve and adjust as necessary on airplanes 801-811 (see Chapter 78).

(12) On airplanes 801-811, pressurize emergency air ejector supply bottle (see Chapter 20).

(13) Close auxiliary hydraulic pump control circuit breaker.

<u>CAUTION:</u> HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

3. <u>Inspection/Check Left Hydraulic Power Manifold</u>

A. Check Left Power Manifold

(1) Check system selector valve (see 29-10-18).

(2) Check bogie swivel unlock valve (see Chapter 32).

(3) Check priority valve (see 29-10-23).

(4) Check emergency air ejector control valve on airplanes 801-811 (see Chapter 78).

(5) Check system selector valve, bogie swivel unlock valve, and priority valve, for security of attachment and leaks.

(6) Check hydraulic lines for security of attachment, general condition, clearance, and leaks.

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RIGHT HYDRAULIC POWER MANIFOLD - MAINTENANCE PRACTICES

1. General

   A. The right hydraulic power manifold is located overhead in the forward inboard corner of the right main gear wheel well.

   B. Access to the right power manifold is through the right main gear inboard door.

2. Removal/Installation Right Hydraulic Power Manifold

   A. Remove Right Power Manifold

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect pushrods from operating cranks of spoiler control valve, slot control valve, wing flap control valve, main gear control valve, and power brake valve (see Chapters 27 and 32).

      (5) Disconnect all hydraulic lines from right hydraulic power manifold.

      (6) Remove brake pressure accumulator line connected between power brake valve and T-fitting on brake pressure accumulator.

      (7) Remove hydraulic lines connected between up and down pressure ports of main gear control valve and T-fittings located on pressure seal bulkhead.

      (8) Disconnect hydraulic lines from spoiler control valve.

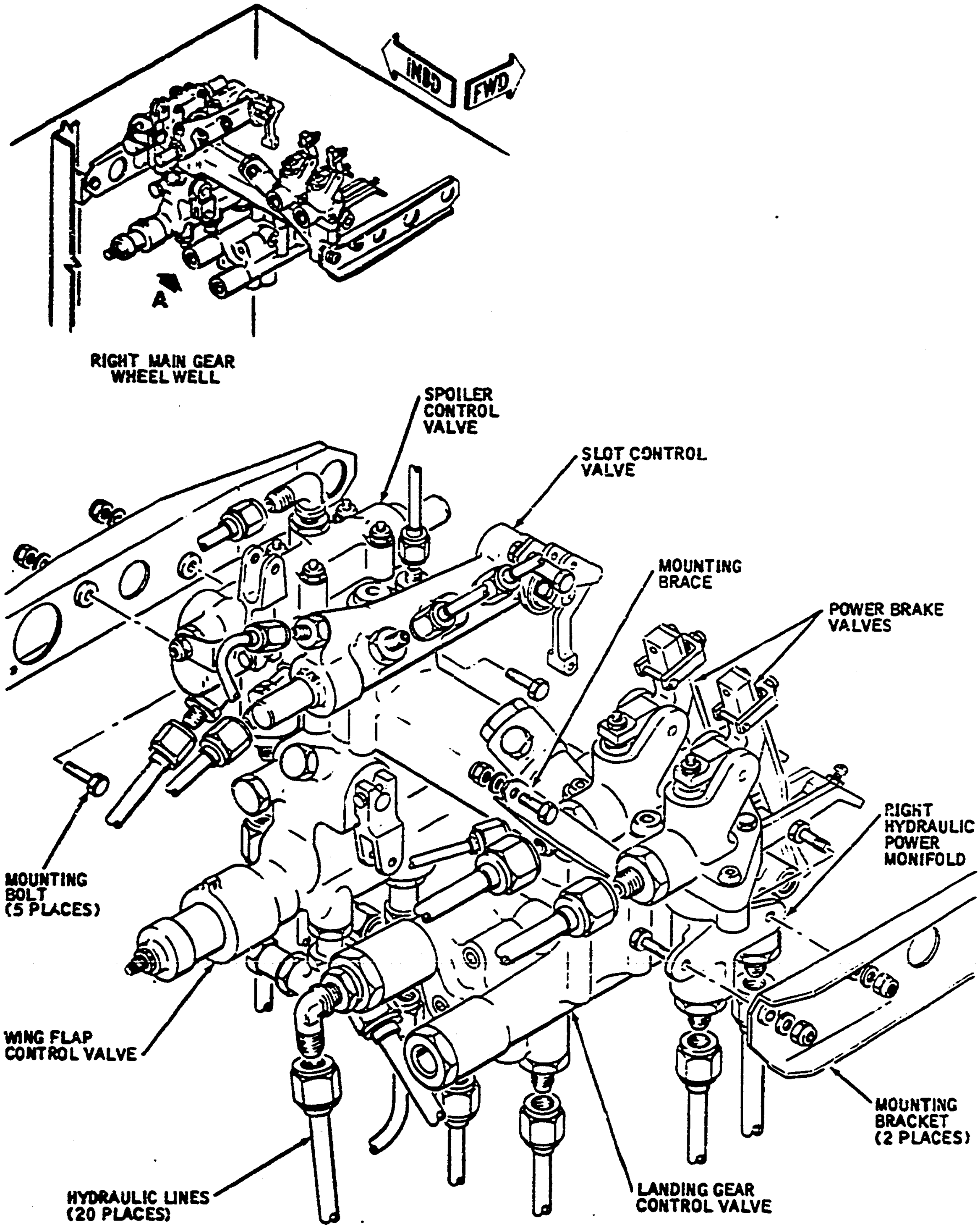
      (9) Disconnect hydraulic lines from wing flap control valve.

      (10) Disconnect hydraulic lines from main gear control valve.

      (11) Disconnect hydraulic lines from slot valve.

      (12) Disconnect hydraulic lines from power brake valve.

      (13) Remove manifold with valves attached.



VIEW A

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Right Hydraulic Power Manifold -- Installation
Figure 201

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B. Install Right Power Manifold

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Install manifold with power brake valve, main gear control valve, wing flap control valve spoiler control valve, and slot valve installed on manifold.

NOTE: Installation of the valves on the manifold is covered in Chapters 27 and 32.

(3) Connect hydraulic lines to power brake valve.

(4) Connect hydraulic lines to main gear control valve.

(5) Connect hydraulic lines to wing flap control valve.

(6) Connect hydraulic lines to spoiler control valve.

(7) Connect hydraulic lines to slot valve.

(8) Install hydraulic lines between up and down ports of main gear control valve and T-fittings located on pressure seal bulkhead.

(9) Install brake pressure accumulator line between power brake valve and T-fitting on brake pressure accumulator.

(10) Connect all hydraulic lines to right hydraulic power manifold.

(11) Connect pushrods to operating cranks on spoiler control valve, wing flap control valve, and slot control valve (see Chapter 27).

(12) Connect pushrods to operating cranks on power brake control valve and main gear control valve (see Chapter 32).

(13) Close auxiliary hydraulic pump control circuit breaker.

3. Inspection/Check Right Hydraulic Power Manifold

A. Check Right Power Manifold

(1) Check main gear control valve and power brake valve as described in Chapter 32.

(2) Check wing flap control valve, spoiler control valve, and slot control valve as described in Chapter 27.

(3) Check hydraulic lines to all components on right power manifold for general condition, security of attachment, clearance, and leaks.

(4) Check all valves which attach to manifold for leaks.

(5) Check pushrods to all valves on manifold for security of attachment, lockwire where applicable, cotter keys, and general condition.

HYDRAULIC MANIFOLDS RETURN CHECK VALVE - MAINTENANCE PRACTICES

1. General

   A. The hydraulic manifolds return check valve is located in return line A, near the dual filter and relief valve on the keel web.

   B. Access to the check valve is through the left main gear wheel well.

2. Removal/Installation Hydraulic Manifolds Return Check Valve

   A. Remove Check Valve

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect A return lines from hydraulic manifolds return check valve.

      (5) Remove check valve.

   B. Install Check Valve

      (1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

      (2) Install manifolds return check valve with flow arrow pointing forward.

      (3) Connect A return lines to each end of check valve.

      (4) Close auxiliary hydraulic pump control circuit breaker.

HYDRAULIC POWER SYSTEM ACCUMULATOR - MAINTENANCE PRACTICES

1. General

   A. The hydraulic power system accumulator is located immediately aft of the left hydraulic power manifold, overhead in the left main gear wheel well.

   B. Access to the accumulator is through the left main gear inboard door.

2. Tools and Equipment Required

   A. Pressure cylinder (clean, dry, compressed nitrogen).

3. Servicing Hydraulic Power System Accumulator

   A. Check Power System Accumulator Pressure

      (1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (2) Check power system accumulator pressure gage; gage should indicate 1000 psi.

      (3) If accumulator requires additional pressurization, proceed as follows:

         (a) Remove filler valve cap.

         (b) Attach nitrogen service hose chuck to filler valve stem.

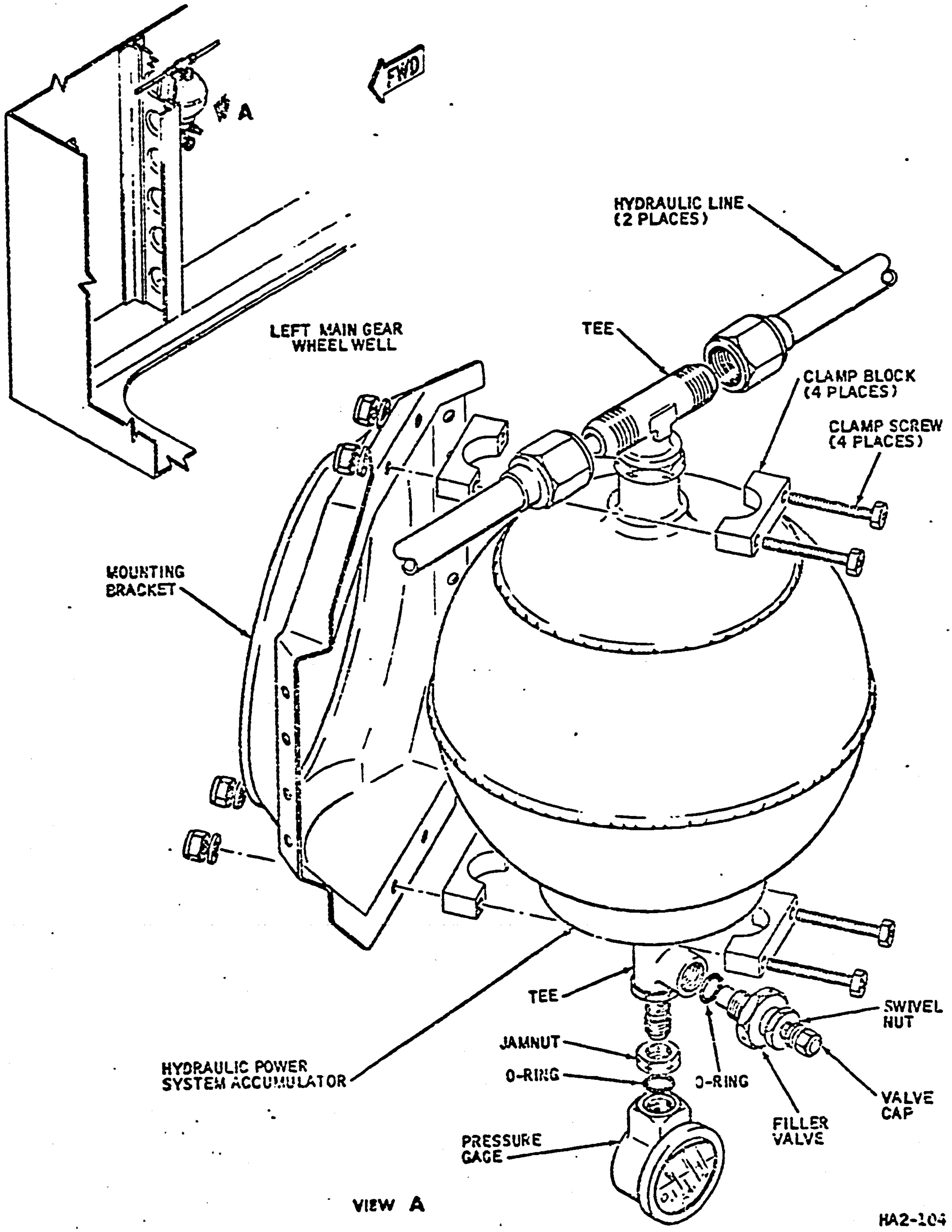
         (c) Loosen filler valve swivel nut a maximum of 3/4 turn.

         (d) Charge accumulator with dry nitrogen to 1000 (±50) psi.

         (e) Tighten swivel nut to torque of 50 to 70 inch-pounds.

         (f) Remove service hose.

         (g) Install valve cap; tighten to maximum fingertightness.



Hydraulic Power System Accumulator -- Installation
Figure 201

4. Removal/Installation Hydraulic Power System Accumulator

A. Remove Power System Accumulator

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Relieve nitrogen pressure from lower chamber of accumulator as follows:

(a) Remove filler valve cap.

(b) Loosen filler valve swivel nut a maximum of 3/4 turn.

(c) Depress filler valve core and hold until pressure has bled off to zero; release valve core and tighten swivel nut.

(d) Install filler valve cap.

(5) Disconnect hydraulic lines from T-fitting at top of accumulator.

(6) Remove accumulator.

(7) Remove T-fitting from top port, and pressure gage and filler valve from lower port fitting; retain for installation in new unit. Discard O-rings.

B. Install Power System Accumulator.

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Using new O-ring, install T-fitting in top port of accumulator.

(3) Using new O-ring, install pressure gage and filler valve on bottom port fitting of accumulator. Made certain that pressure gage is properly positioned and filler valve is accessible after accumulator is installed.

(4) Install accumulator.

(5) Connect hydraulic lines to T-fitting at top of accumulator.

(6) Charge accumulator with dry nitrogen (see paragraph 3).

(7) Close auxiliary hydraulic pump control circuit breaker.

5. Inspection/Check Hydraulic Power System Accumulator

A. Check Power System Accumulator

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check accumulator upper port and hydraulic lines for leaks.

(3) Check accumulator lower port, filler valve, and pressure gage for general condition, gage position for ease of reading, filler valve for accessibility, and connections for nitrogen leaks.

(4) Check accumulator and mounting clamps for general condition and security of attachment.

(5) Depressurize hydraulic system (see 29-00, Maintenance Practices).

HYDRAULIC SYSTEM PRIORITY VALVE - MAINTENANCE PRACTICES

1. General

A. The priority valve is located directly below the left power manifold in the overhead area of the left main gear wheel well approximately 12 inches aft of the rear spar.

B. Access to the priority valve is through the left main gear inboard door.

2. Removal/Installation Hydraulic System Priority Valve

A. Remove Priority Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect hydraulic lines from T-fitting at lower end of priority valve.

(5) Remove clamp and unscrew priority valve from T-fitting in manifold port Discard O-ring.

(6) Remove fitting from priority valve; retain for use in new unit. Discard O-ring.

B. Install Priority Valve

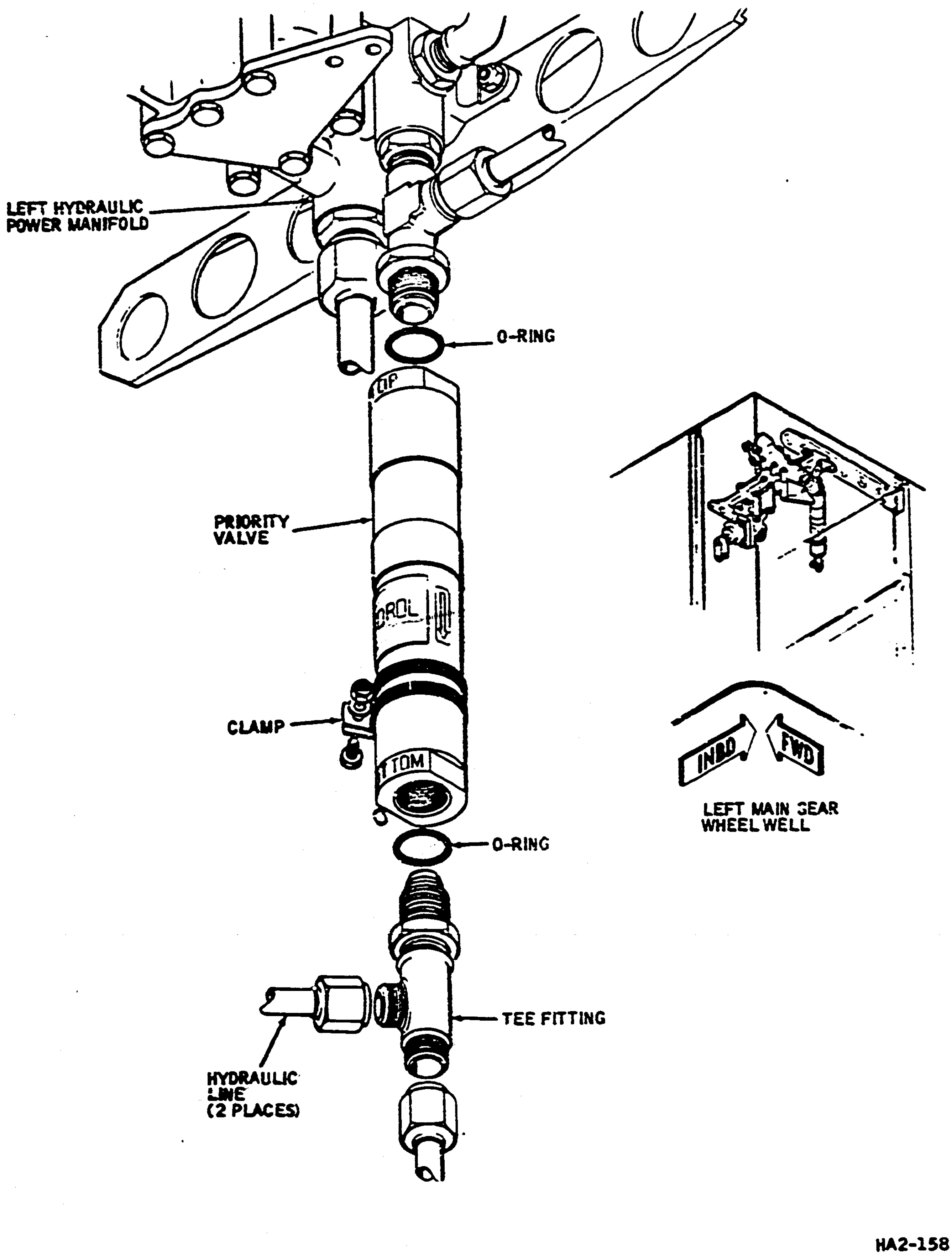
(1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

(2) Using new O-ring, screw priority valve on T-fitting in manifold port.

NOTE: Make certain that arrow on priority valve points downward.

(3) Install clamp to secure priority valve.

(4) Using new O-ring, install fitting in bottom of priority valve.



Hydraulic System Priority Valve -- Installation
Figure 201

(5) Connect hydraulic lines to T-fitting in lower end of valve.

(6) Close auxiliary hydraulic pump circuit breaker.

(7) Fill hydraulic reservoir as required (see instruction placard on reservoir).

CAUTION: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

3. Inspection/Check Hydraulic System Priority Valve

A. Check Priority Valve

(1) Connect hydraulic test stand to ground service connections.

(2) Place aileron hydraulic power and rudder hydraulic power shutoff valve control levers in on position.

(3) Place hydraulic system selector control lever in general system (normal) position.

(4) Set hydraulic test stand at approximately 5 gpm fluid flow, and pressurize hydraulic system to 2000 psi.

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR LOCKPINS ARE INSTALLED.

(5) Place wing flap handle in down position.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(6) While flaps are moving down, reduce test stand pressure until flaps just stop. Test stand pressure should be 1650-psi minimum.

(7) Hydraulic system pressure indicator in flight compartment should indicate 250 psi or lower.

(8) Operate ailerons or rudder to make certain that flight controls still have pressure.

NOTE: If controls are operated too fast, ailerons or rudder will revert to manual operation when system pressure drops below 1100 (+100, -50) psi.

(9) Increase test stand pressure until flaps just start to move. Test stand pressure should be 2000 (+100, -50) psi.

(10) Pressurize hydraulic system to full system pressure (3000 psi) (see 29-00).

(11) Check priority valve hydraulic connections for leaks.

(12) Check priority valve for security of attachment and general condition.

(13) Check hydraulic lines for clearance and general condition.

(14) Shut down and disconnect hydraulic test stand.

HYDRAULIC SYSTEM PRIORITY VALVE - MAINTENANCE PRACTICES

1. General

   A. The priority valve is located directly below the left power manifold in the overhead area of the left main gear wheel well approximately 12 inches aft of the rear spar.

   B. Access to the priority valve is through the left main gear inboard door.

2. Removal/Installation Hydraulic System Priority Valve

   A. Remove Priority Valve

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect hydraulic lines from T-fitting at lower end of priority valve.

      (5) Remove clamp and unscrew priority valve from T-fitting in manifold port. Discard O-ring.

      (6) Remove fitting from priority valve; retain for use in new unit. Discard O-ring.

   B. Install Priority Valve

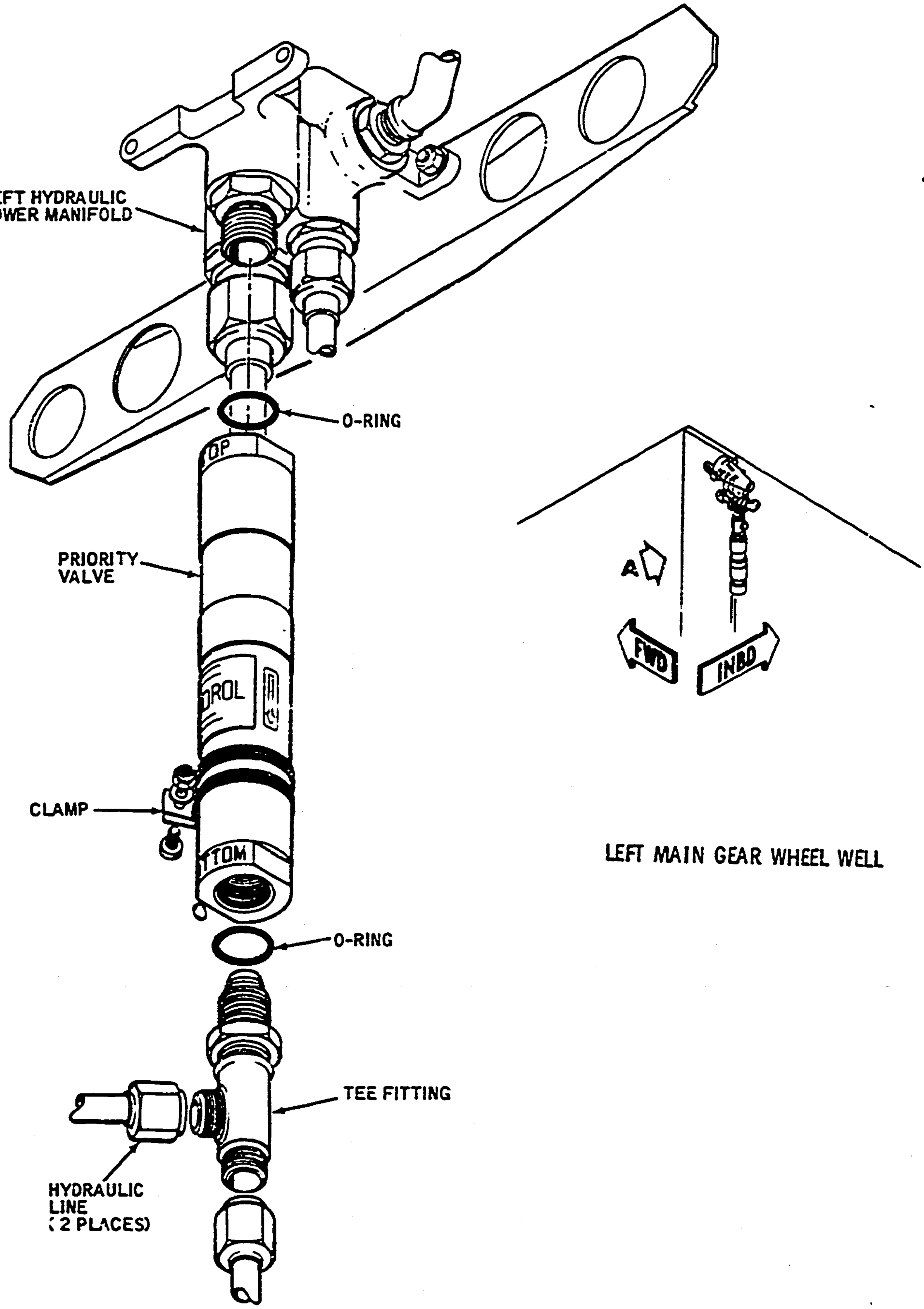
      (1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

      (2) Using new O-ring, screw priority valve on T-fitting in manifold port.

      NOTE: Make certain that arrow on priority valve points downward.

      (3) Install clamp to secure priority valve.

      (4) Using new O-ring, install fitting in bottom of priority valve.



VIEW A

HA2-880A

Hydraulic System Priority Valve -- Installation
Figure 201

(5) Connect hydraulic lines to T-fitting in lower end of valve.

(6) Close auxiliary hydraulic pump circuit breaker.

(7) Fill hydraulic reservoir as required (see instruction placard on reservoir).

CAUTION: HYDRAULIC POWER MANIFOLD PROTECTION GUARD, LOCATED IN FORWARD INBOARD CORNER OF LEFT MAIN GEAR WHEELWELL, MUST BE INSTALLED WITH LOWER, OUTBOARD LEG UNDER SPOILER CABLE TO AVOID CHAFFING THE CABLES, GUARD, AND EMPENNAGE HYDRAULIC LINES.

3. Inspection/Check Hydraulic System Priority Valve

A. Check Priority Valve

(1) Connect hydraulic test stand to ground service connections.

(2) Place aileron hydraulic power and rudder hydraulic power shutoff valve control levers in on position.

(3) Place hydraulic system selector control lever in general system (normal) position.

(4) Set hydraulic test stand at approximately 5 gpm fluid flow, and pressurize hydraulic system to 2000 psi.

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR LOCKPINS ARE INSTALLED.

(5) Place wing flap handle in down position.

WARNING: MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(6) While flaps are moving down, reduce test stand pressure until flaps just stop. Test stand pressure should be 1650-psi minimum.

(7) Hydraulic system pressure indicator in flight compartment should indicate 250 psi or lower.

(8) Operate ailerons or rudder to make certain that flight controls still have pressure.

NOTE: If controls are operated too fast, ailerons or rudder will revert to manual operation when system pressure drops below 1100 (+100, -50) psi.

(9) Increase test stand pressure until flaps just start to move. Test stand pressure should be 2000 (+100, -50) psi.

(10) Pressurize hydraulic system to full system pressure (3000 psi) (see 29-00).

(11) Check priority valve hydraulic connections for leaks.

(12) Check priority valve for security of attachment and general condition.

(13) Check hydraulic lines for clearance and general condition.

(14) Shut down and disconnect hydraulic test stand.

TWO-STAGE RETURN FILTERS - MAINTENANCE PRACTICES

1. General

   A. The two-stage return filters are located on the outboard bulkhead of the left main gear wheel well, just aft of the wing rear spar. One filter is connected in the A return line and the other is connected in the B return line; both are just upstream of the reservoir return fluid manifold.

   B. Access to the filters is through the left main gear inboard door.

   C. Removal/installation and inspection/check procedures for the two-stage return filters are identical except as noted.

2. Removal/Installation Two-Stage Return Filters

   A. Remove Two-Stage Return Filter

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) If two-stage return filter in A return line is being removed, drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      NOTE: The B return line has a check valve at the reservoir to prevent siphoning of hydraulic fluid from the reservoir.

      (5) Disconnect hydraulic lines to inlet and outlet ports of filter.

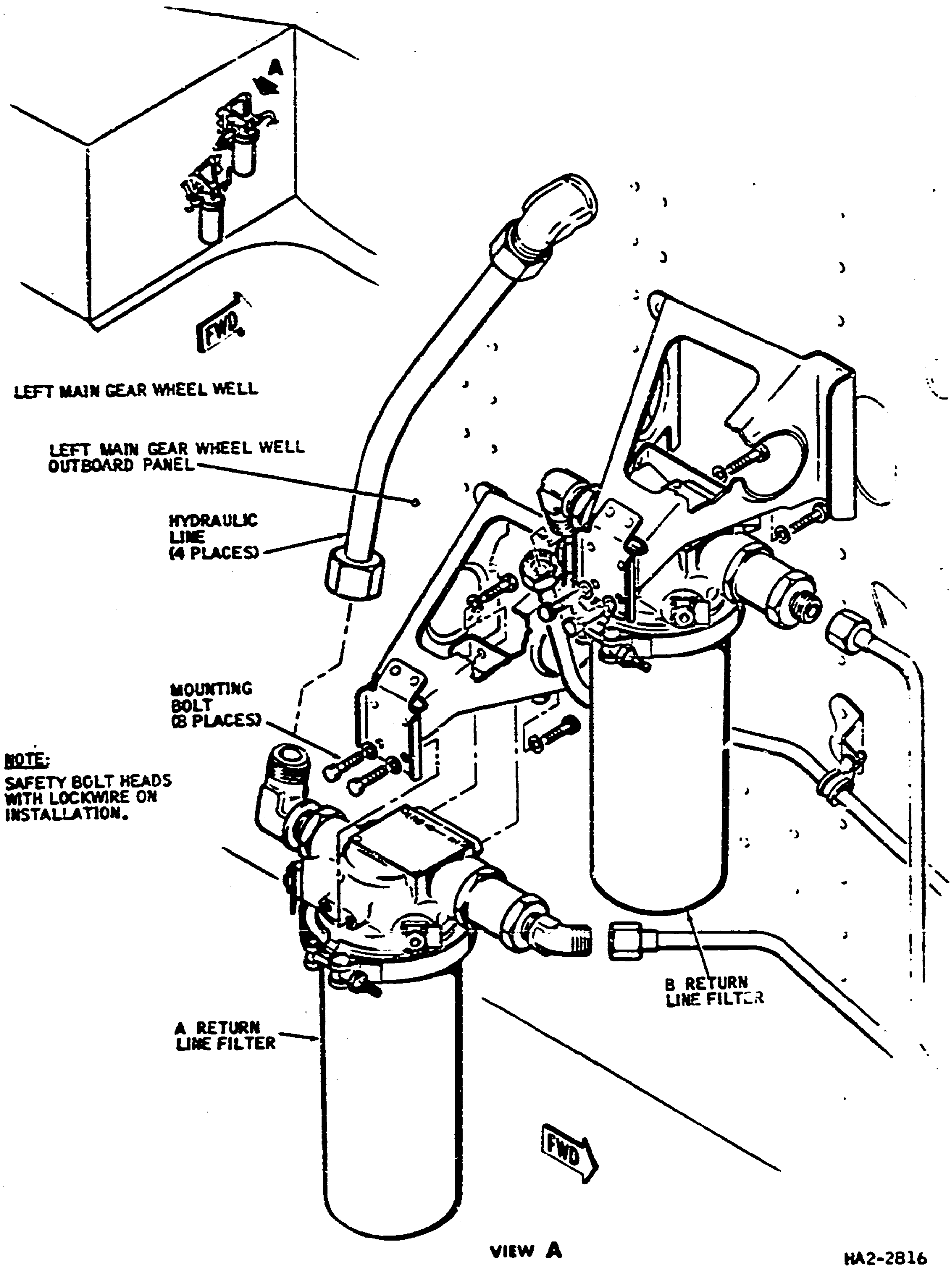
      (6) Remove filter.

      (7) Remove fittings from inlet and outlet ports of filter and retain for use in new unit. Discard O-rings.

   B. Install Two-Stage Return Filter

      (1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

      (2) Using new O-rings, install fittings in inlet and outlet ports of filter.



Two-Stage Return Filters -- Installation
Figure 201

(3) Fill filter bowl and elements with clean hydraulic fluid.

(4) Install filter and safety mounting bolts with lockwire.

(5) Connect hydraulic lines to inlet and outlet ports of filter.

(6) Depress both primary and secondary stage differential pressure indicator buttons.

(7) Close auxiliary hydraulic pump control circuit breaker.

(8) If two-stage filter in A return line is being installed and hydraulic system reservoir was drained for filter removal, fill hydraulic system reservoir (see instruction placard on reservoir).

3. <u>Inspection/Check Two-Stage Return Filters</u>

A. Check Two-Stage Return Filter

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check two-stage return filter for leaks, general condition, security of mounting, and proper lockwire safety.

(3) Check that both primary and secondary stage differential pressure indicator buttons are depressed.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

TWO-STAGE RETURN FILTER ELEMENTS - MAINTENANCE PRACTICES

1. General

A. The two-stage return filters are located on the outboard bulkhead of the left main gear wheel well, just aft of the wing rear spar. One filter is connected in the A return line and the other is connected in the B return line; both are just upstream of the reservoir return fluid manifold. Each filter contains a primary stage and a secondary stage filter element. The primary stage element is of the disposable type and the secondary stage element is of the cleanable type. The secondary stage element is smaller in diameter than the primary stage element and is located inside the primary stage element in a concentric assembly.

B. The ultrasonic method is recommended for cleaning the stainless steel mesh secondary stage elements.

C. Access to the filters is through the left main gear inboard door.

D. Removal/installation and inspection/check procedures for the filter elements are identical for the A return and B return two-stage filters.

2. Tools and Equipment Required

A. Varsol cleaning solvent (Federal Specification TT-T-291) is used for cleaning filter head and bowl.

3. Removal/Installation Two-Stage Return Filter Elements

A. Remove Two-Stage Return Filter Elements

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

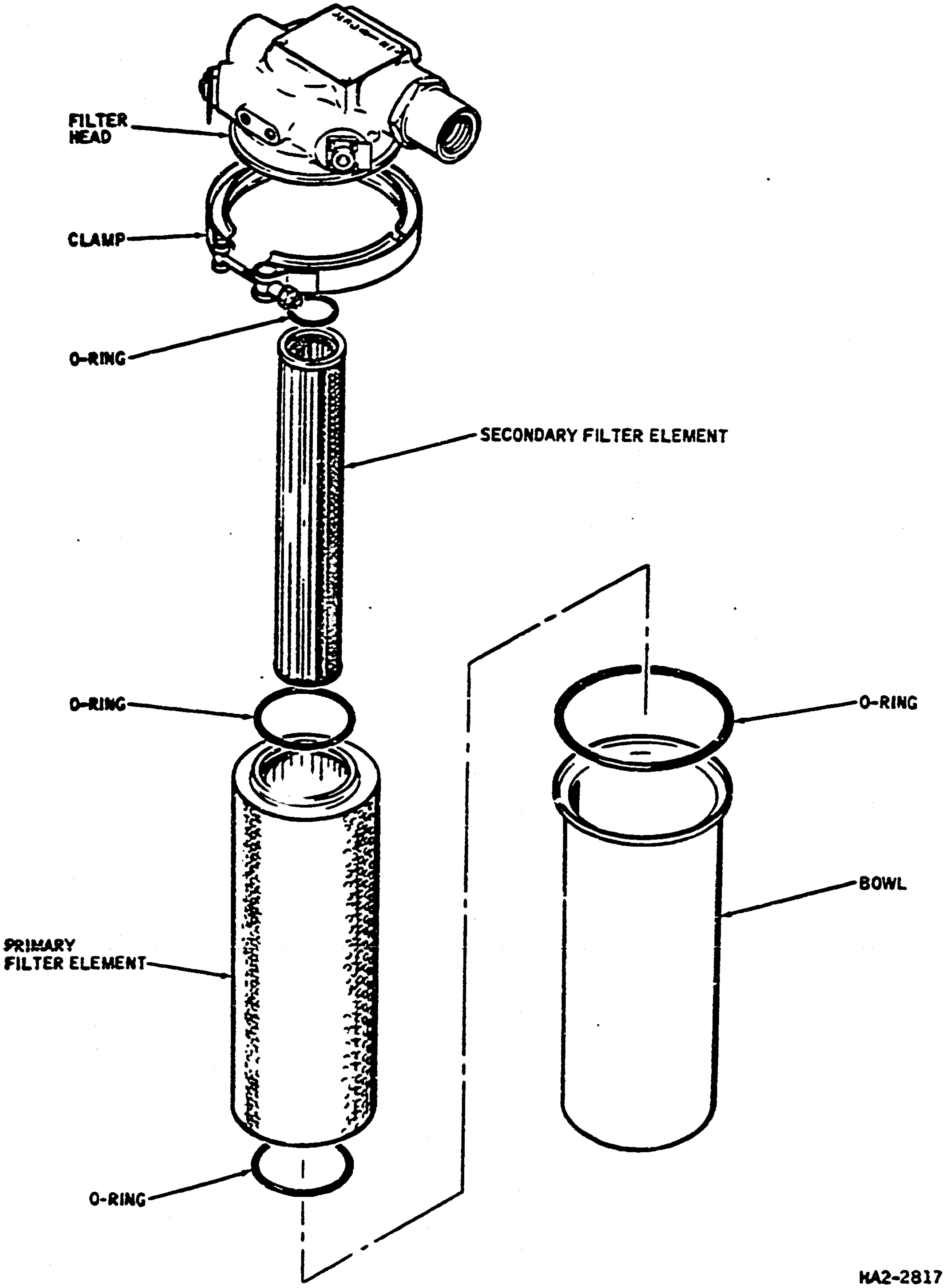
WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) If removing elements from two-stage return filter in A return line, drain hydraulic system reservoir (see 29-00, Maintenance Practices).

NOTE: The B return line has a check valve at the reservoir to prevent siphoning of hydraulic fluid from the reservoir.



Two-Stage Return Filter Elements -- Installation
Figure 201

(5) Remove filter bowl clamp and filter bowl. Discard O-ring.

(6) Remove primary and secondary stage filter elements from filter head. Discard O-rings and primary stage filter element.

(7) Wash filter bowl and filter head with clean Varsol (Federal Specification TT-T-291) and air dry.

B. Install Two-Stage Return Filter Elements

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Using new O-rings, install filter elements on filter head.

(3) Fill filter bowl with clean hydraulic fluid.

(4) Using new O-ring, install filter bowl and bowl clamp.

(5) Tighten clamp to torque of 60 to 84 inch-pounds.

(6) Depress both primary and secondary stage differential pressure indicators buttons.

(7) If elements are being installed in two-stage return filter in A return line and reservoir was drained for removal, fill hydraulic system reservoir (see instruction placard on reservoir).

(8) Close auxiliary hydraulic pump control circuit breaker.

4. <u>Inspection/Check Two-Stage Return Filter Elements</u>

A. Check Two-Stage Return Filter Elements

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check two-stage return filter for leaks around filter bowl to head clamp joint.

(3) Check that both primary and secondary stage differential pressure indicator buttons are depressed.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

MANUAL SHUTOFF VALVES - MAINTENANCE PRACTICES

1. General

A. The manual shutoff valves are located in the upper inboard, forward corner of the left main gear wheel well. One valve is mounted on the left hydraulic power manifold support, the other is mounted on a structure stiffener on the rear wing spar web. The valves are connected in the pressure lines between the outlet side of the priority valve and non-priority subsystems downstream of the priority valve.

B. Access to the manual shutoff valves is through the left main gear inboard door. Removal and installation procedures for the manual shutoff valves are identical.

2. Removal/Installation Manual Shutoff Valves

A. Remove Manual Shutoff Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect hydraulic lines to inlet and outlet ports of valve.

(5) Remove valve from manifold support or structure stiffener as applicable.

B. Install Manual Shutoff Valve

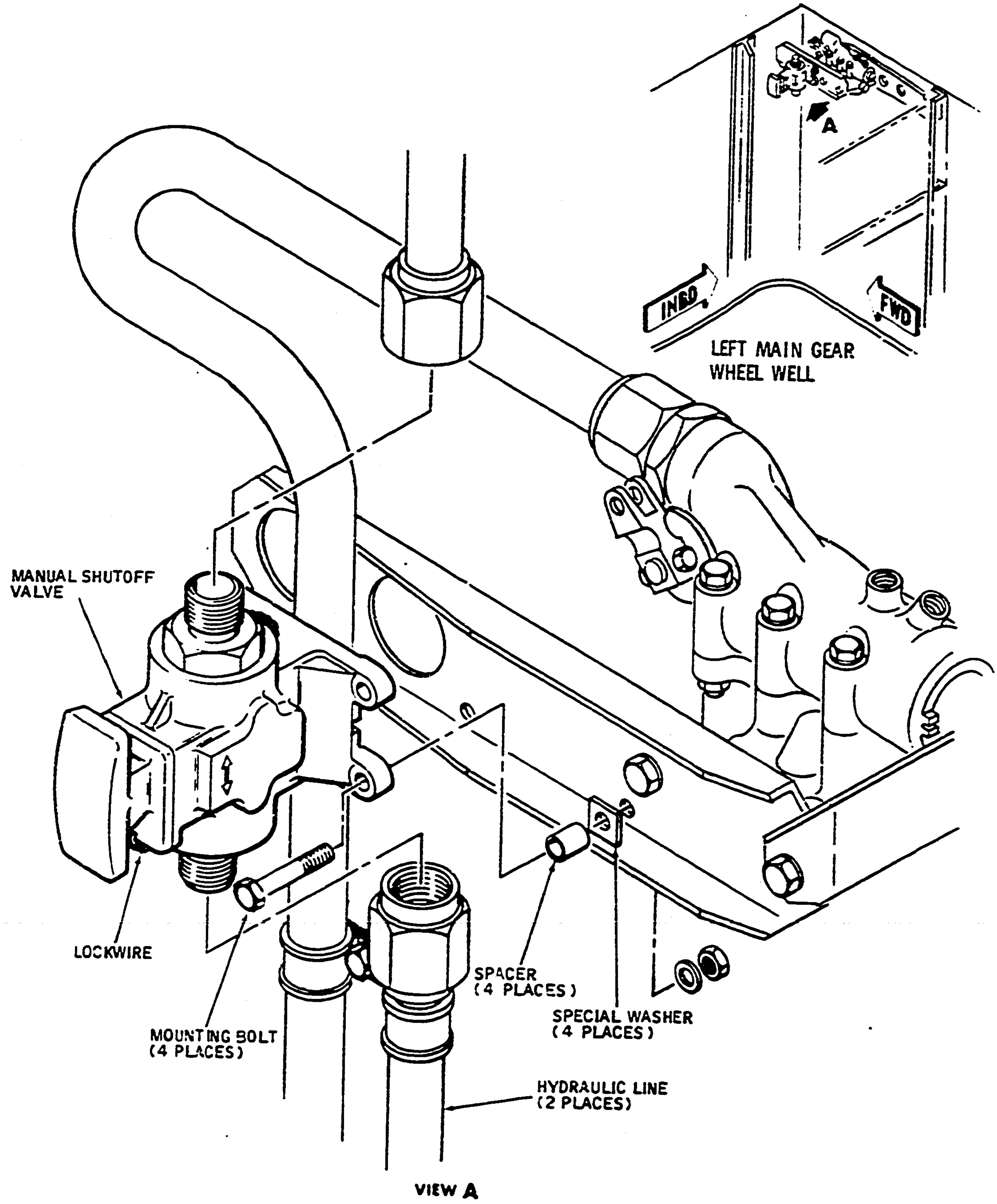
(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Install valve on manifold support, or structure stiffener as applicable.

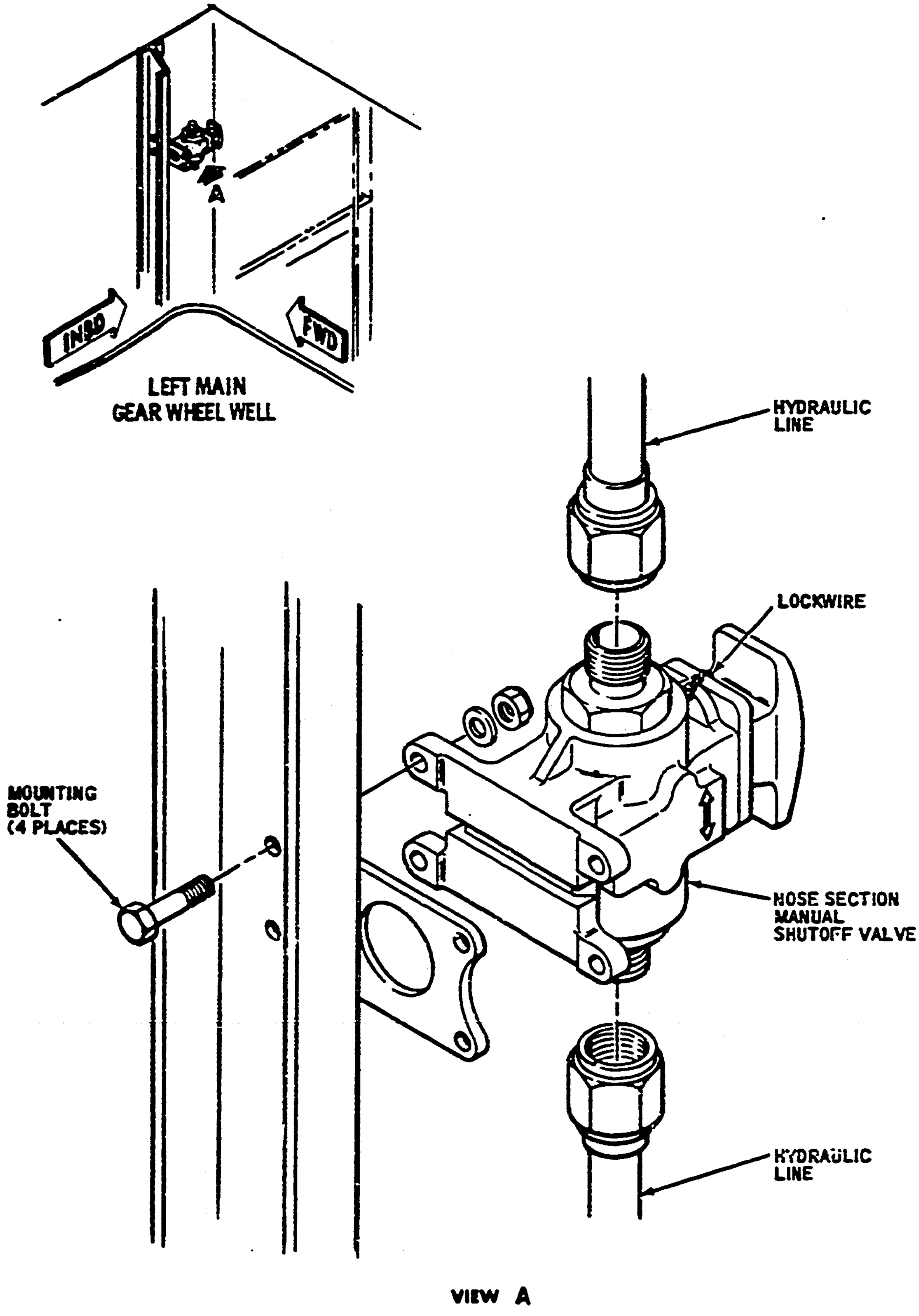
(3) Connect hydraulic lines to inlet and outlet ports of valve.

(4) Safety valve handle in open position with lockwire.

(5) Close auxiliary hydraulic pump control circuit breaker.



Manual Shutoff Valve -- Installation
Figure 201 (Sheet 1)



Manual Shutoff Valve -- Installation
Figure 201 (Sheet 2)

3. <u>Inspection/Check Manual Shutoff Valve</u>

A. Check Manual Shutoff Valve

(1) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check manual shutoff valve for external leaks and general condition.

(3) Depressurize hydraulic system (see 29-00, Maintenance Practices).

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ENGINE-DRIVEN HYDRAULIC PUMP DISPOSABLE CASE DRAIN FILTER - MAINTENANCE PRACTICES

1. General

   A. The engine-driven hydraulic pump disposable case drain filters are located, one each, on the case drain port of each engine-driven hydraulic pump.

   B. Access to the disposable filters and hydraulic pumps is through the engine nacelle doors and removal of the engine bypass duct (see Chapter 78).

   C. Removal/Installation procedures for the left and right engine-driven hydraulic pump disposable case drain filters are identical, except as noted.

2. Removal/Installation Engine-Driven Hydraulic Pump Disposable Case Drain Filters

   A. Remove Disposable Case Drain Filter

      (1) Open engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Place fire control handles in fuel, air, and hydraulic off position.

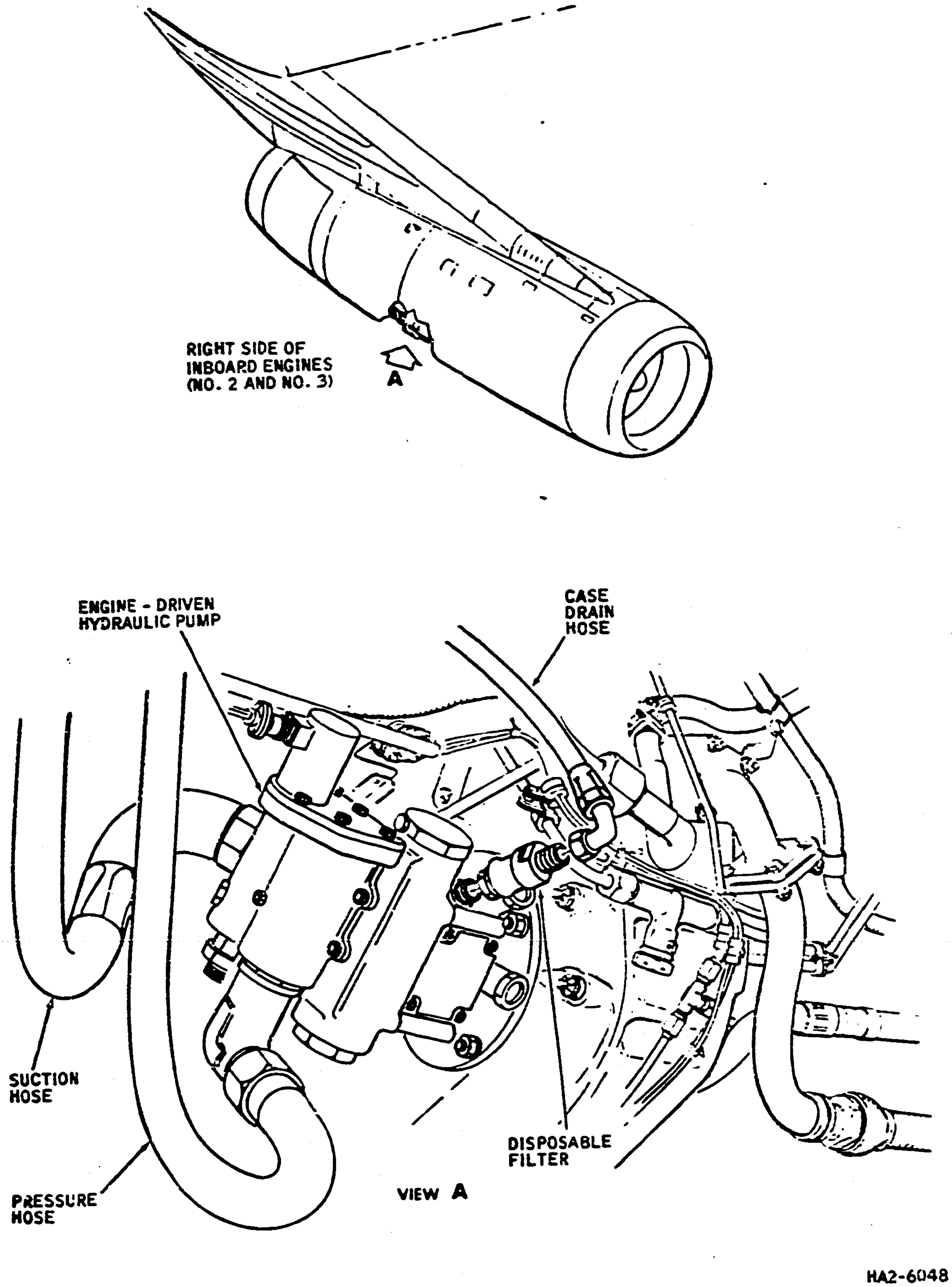
      (3) Disconnect case drain hose from disposable case drain filter outlet port.

      CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN THE ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

      (4) Remove disposable filter from pump.

   B. Install Disposable Case Drain Filter

      (1) Make certain that engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel are open.



Engine-Driven Hydraulic Pump Disposable Case
Drain Filter -- Installation
Figure 201

(2) Install disposable case drain filter in engine-driven hydraulic pump case drain port.

CAUTION: THE FIRE DETECTOR SENSING ELEMENTS WHICH ARE INSTALLED WITHIN THE ENGINE AREA ARE VERY SENSITIVE. PHYSICAL CONTACT WITH THESE ELEMENTS CAN CAUSE HIDDEN DAMAGE. A CONSTANT DIMENSION MUST BE MAINTAINED BETWEEN ELEMENTS AND THEIR SUPPORTING STRUCTURE. A MINIMUM CLEARANCE OF 3/4-INCH MUST BE MAINTAINED BETWEEN ELEMENTS AND ENGINE COMPONENTS AND LINES.

(3) Connect case drain hose to outlet port of filter.

(4) Place fire control handles in normal position.

(5) Reset generator (see Chapter 24).

(6) Close engine 2 and 3 hydraulic pump bypass circuit breaker located on miscellaneous (dc bus) section of EPC circuit breaker panel.

(7) Check for leaks at disposable filter during next scheduled engine run (see paragraph 3).

3. Inspection/Check Engine-Driven Hydraulic Pump Disposable Case Drain Filter

A. Check Disposable Case Drain Filter

(1) Start engines No. 2 and/or 3 (see Chapter 71).

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Check hydraulic pressure indicator for 2800- to 3000-psi system pressure.

(4) Shut down engine(s). (see Chapter 71).

(5) Check disposable filter(s) for leaks at pump case drain port and at filter outlet connection.

AUXILIARY - DESCRIPTION AND OPERATION

1. General

A. The auxiliary hydraulic system is a supplementary hydraulic power system connected to the main hydraulic power system through the system selector valve and the auxiliary pump supply selector valve. The auxiliary hydraulic system consists of an electrically driven auxiliary hydraulic pump, an auxiliary pump relief valve, a surge damper accumulator, and auxiliary filter and check valve, and the piping required to interconnect the components and connect the auxiliary system to the main power system.

B. In flight, the auxiliary hydraulic system can be used as supplemental power for the main power system. The auxiliary pump will also serve, when ground support equipment is not available, to pressurize the hydraulic power system for ground testing of the airplane hydraulic subsystems and components. Fluid is supplied to the auxiliary pump from a low standpipe in the hydraulic system reservoir. When the auxiliary pump is operated, fluid from the pressure outlet port of the auxiliary pump is ported, through the auxiliary power system filter and an auxiliary system check valve, to the auxiliary pressure inlet port of the system selector valve. When the system selector valve is in the normal position, auxiliary pump pressure is ported to the general system.

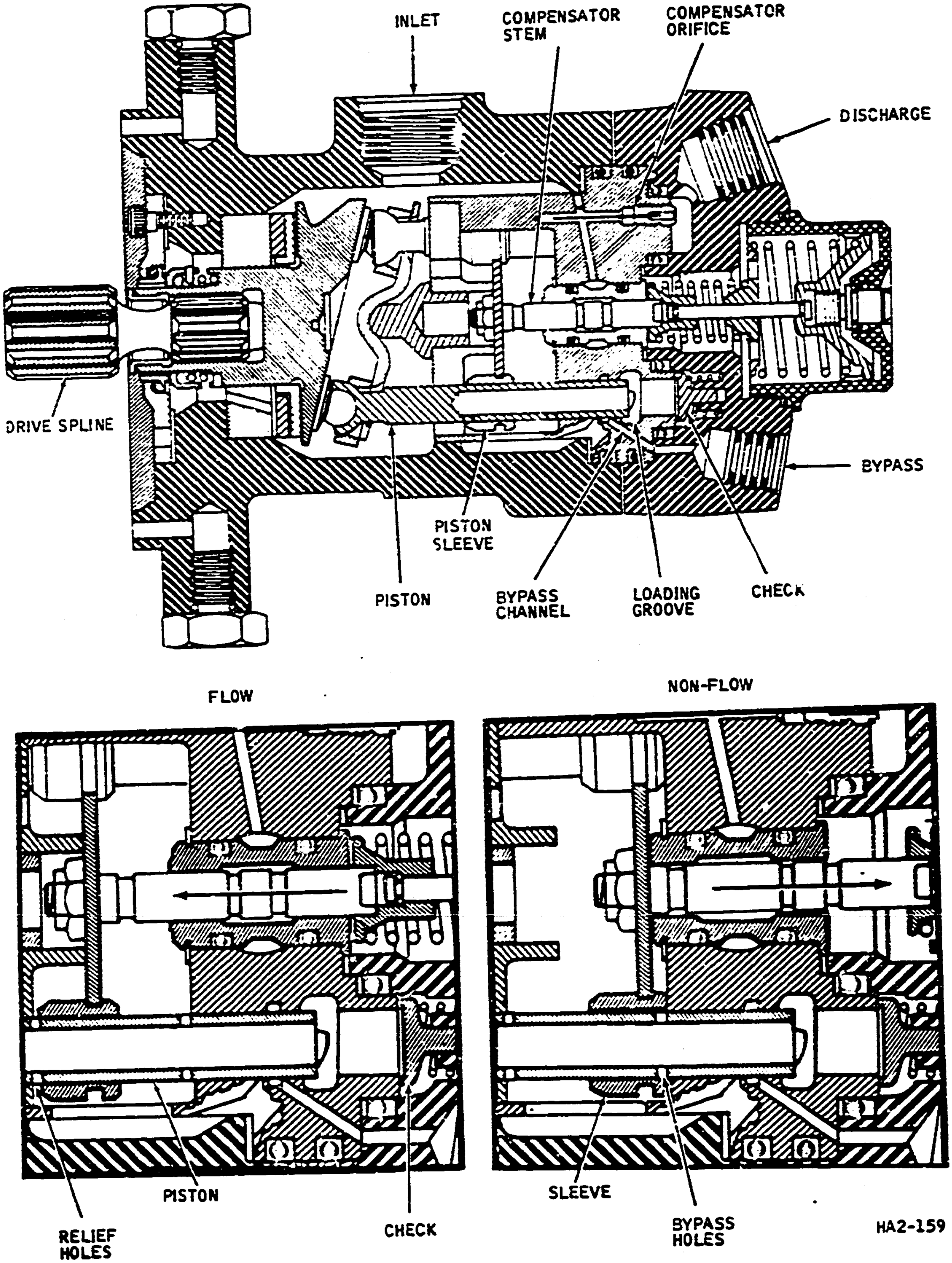
C. When the auxiliary pump is not operating, the auxiliary system check valve prevents reverse flow through the auxiliary pump from the engine-driven pumps. An auxiliary pump relief valve is teed into the line from the auxiliary pump outlet port to the reservoir filter inlet port. The valve relieves and ports excess fluid pressure back to the reservoir if auxiliary pressure builds above 3300 psi.

D. The auxiliary pump alternate reservoir is installed in the auxiliary hydraulic system to provide an alternate hydraulic fluid source in case of depletion of the normal supply to the hydraulic system reservoir. The alternate reservoir source is selectable by operation of the auxiliary hydraulic pump supply selector valve which actuates simultaneously with the hydraulic system selector valve.

2. System Components

A. Auxiliary Hydraulic Pump (See Figure 1.)

(1) The auxiliary hydraulic pump is an electrically driven, continuous-duty pressure-compensated, variable-displacement pump. An automatic pressure-sensing mechanism (compensator) within the pump regulates the amount of fluid delivered to the airplane hydraulic system. The quantity of delivery is dependent on the system pressure. Flow is reduced to zero when desired system pressure is achieved.



Auxiliary Hydraulic Pump -- Cutaway View
Figure 1

(2) The internal components of the pump perform three major functions; mechanical drive (motor), fluid displacement (pistons), and pressure control (compensator). Mechanical drive is supplied by a 200-vac, 3-phase, 400-cycle electric motor.

(3) As the hydraulic fluid from the reservoir enters the inlet port, the fluid is displaced by axial piston motion. As a piston advances in a cylinder bore, it forces a quantity of fluid past the pump check at the end of the bore. When the piston bypass holes become aligned hydraulically with the cylinder block passage, pressurized fluid also escapes to bypass; then a combination of spring pressure and system back pressure closes the pump checks. In the withdrawal portion of the piston stroke, a partial vacuum is created in the cylinder bore, allowing new fluid from the intake to flow into the bore from the pressurized reservoir. The quantity of fluid delivered by each piston stroke is controlled by relief holes in the pistons and piston sleeves.

(4) Unless the relief holes are covered by the piston sleeves, no fluid is forced past the pump checks. Quantity of delivery is therefore determined by the position of the piston sleeves, which in turn is determined by system pressure bled through the compensator orifices. Because one sleeve is slightly longer than the others, the pump, even when in full cutoff, continues to pump enough fluid to make up for any minor drop in the system pressure due to leakage.

(5) Pressure control: System pressure, acting through the compensator orifice on the compensator stem, controls the piston sleeve position and and, therefore, determines whether the pump delivers at full capacity, partial capacity, or cuts off entirely. Path of fluid flow through the pump remains the same in all three conditions. When the pressure at the outlet port reaches 2700 psi, pressure in the compensator commences to reduce the output until 3000 psi is reached, at which time fluid flow is zero. The bypass system is provided to supply self-lubrication, particularly when the pump is in non-delivery (cutoff) operation. The ring of bypass holes in the pistons is hydraulically aligned with the bypass passage each time a piston reaches the very end of its forward travel period. This pumps a small quantity of fluid out the bypass passage back to the supply reservoir and provides a constant changing of the fluid in the pump. The bypass is designed to pump against a considerable back pressure for use with pressurized hydraulic reservoirs.

B. Auxiliary Hydraulic Pump Alternate Reservoir

(1) The auxiliary hydraulic pump alternate reservoir is installed on the shear web in the left wing root area, immediately aft of the auxiliary hydraulic pump. Access to the reservoir is through the left wing root access door. The alternate reservoir supplies hydraulic fluid to the auxiliary hydraulic pump in the event the fluid supply from the main hydraulic system reservoir is exhausted.

(2) The reservoir is cylindrical in shape and has a fluid capacity of approximately 1.9 US gallons (1.6 Imperial gallons or 7.3 liters). There are four ports on the reservoir: an outlet port to the auxiliary hydraulic pump selector valve located at the bottom, an inlet port from the auxiliary hydraulic pump bypass located near the top on the side, an inlet from the wing flap return line, and an outlet to the main hydraulic reservoir located at the top. A sight gage is installed near the top of the reservoir for visual indication of fluid level, and a mounting boss for the emergency hydraulic level indicating light switch is installed on the side of the reservoir.

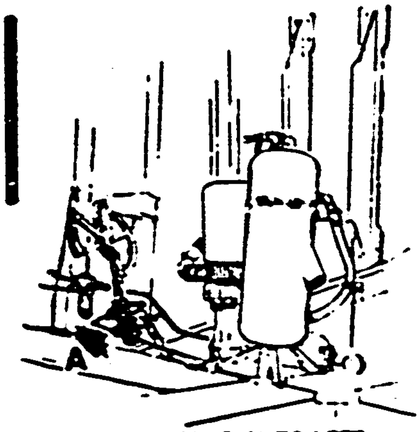
(3) The reservoir is kept full during operation by routing fluid from the wing flap return line to the reservoir. Fluid in excess of the alternate reservoir capacity is then routed to the main hydraulic system reservoir. Hydraulic fluid from the auxiliary pump bypass is routed to the alternate reservoir and then to the main reservoir. Fluid is used from the alternate reservoir only when the auxiliary pump is operating and the auxiliary pump supply selector valve is in the alternate position. Fluid supply to the alternate reservoir is replenished whenever the wing flaps are operated.

C. Auxiliary Hydraulic Pump Supply Selector Valve (See Figure 2.)

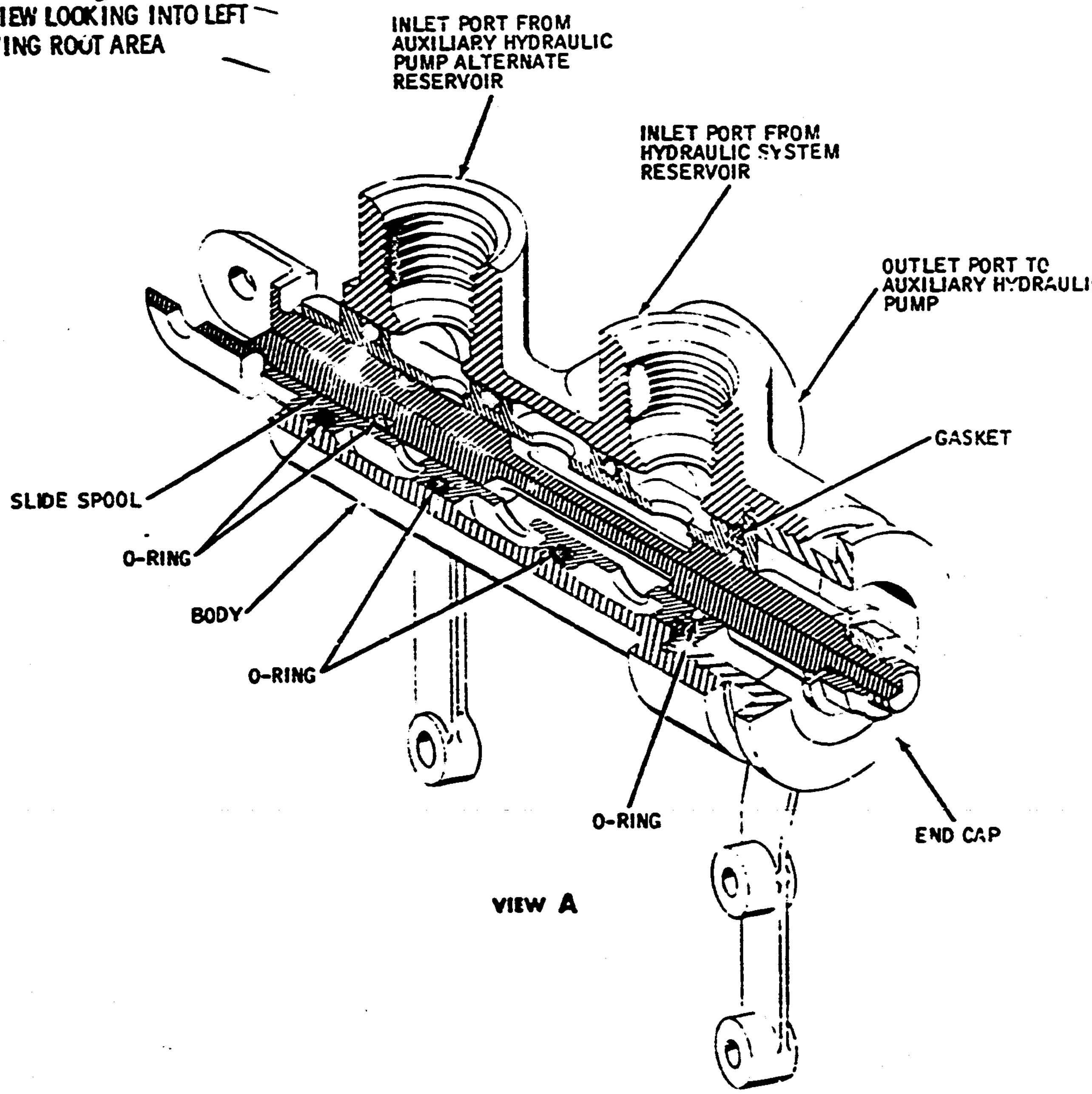
(1) The auxiliary hydraulic pump supply valve is a 2-position valve that ports hydraulic fluid from the reservoir, through a common outlet, to the auxiliary pump. The selector valve is located on the shear web in the left wing root, near the auxiliary pump. The selector valve is accessible through the left wing root access door.

(2) The valve body has two inlet ports and one outlet port. The outlet port is centrally located on the aft side of the valve body. The two inlet ports are located on the outboard side of the valve body, 90 degrees from the outlet port. Two mounting flanges are located on the inboard side of the valve body. These flanges are an integral part of the valve body.

(3) During normal operation, fluid is taken from a low standpipe in the main hydraulic system reservoir and ported to the auxiliary pump. When the valve is in the alternate position, fluid is taken from the auxiliary hydraulic pump alternate reservoir and ported to the auxiliary pump. The valve is moved from the auxiliary position to the alternate position by placing the hydraulic system selector control lever, located on the system engineer's control pedestal, to the general system/main gear downlock and flaps position.



VIEW LOOKING INTO LEFT
WING ROOT AREA



VIEW A

HA2-160A

Auxiliary Hydraulic Pump Supply Selector
Valve -- Cutaway View
Figure 2

D. Auxiliary Hydraulic Pump Relief Valve (See Figure 3.)

(1) The auxiliary hydraulic pump relief valve is a spring loaded poppet-type valve and serves to relieve excess fluid pressure that may build up in the auxiliary hydraulic system. The relief valve connects, through a reducer, to a tee in the A return port of the hydraulic system reservoir. The valve is accessible through the left wing root access door.

(2) Externally, the valve body is cylindrical, approximately 5 inches in length, and 1 inch in diameter. The outlet end of the valve is slightly larger than the inlet end.

(3) When pressure builds up, the poppet starts to relieve at approximately 3300 psi. If pressure continues to build up, the poppet continues to open until 3500 psi and a maximum flow of 3.5 gpm are reached. When pressure is relieved, the poppet reseats at 90 percent of the unseat pressure.

E. Auxiliary Hydraulic System Filter (See Figure 4.)

(1) A line-type, 10-micron filter assembly is installed in the piping of the auxiliary system to filter fluid from the pressure outlet port of the auxiliary pump to the system selector valve. The filter is located on the bulkhead near the forward inboard corner of the left main gear wheel well, slightly inboard and above the dual filter and relief valve. It is accessible through the left main gear inboard door.

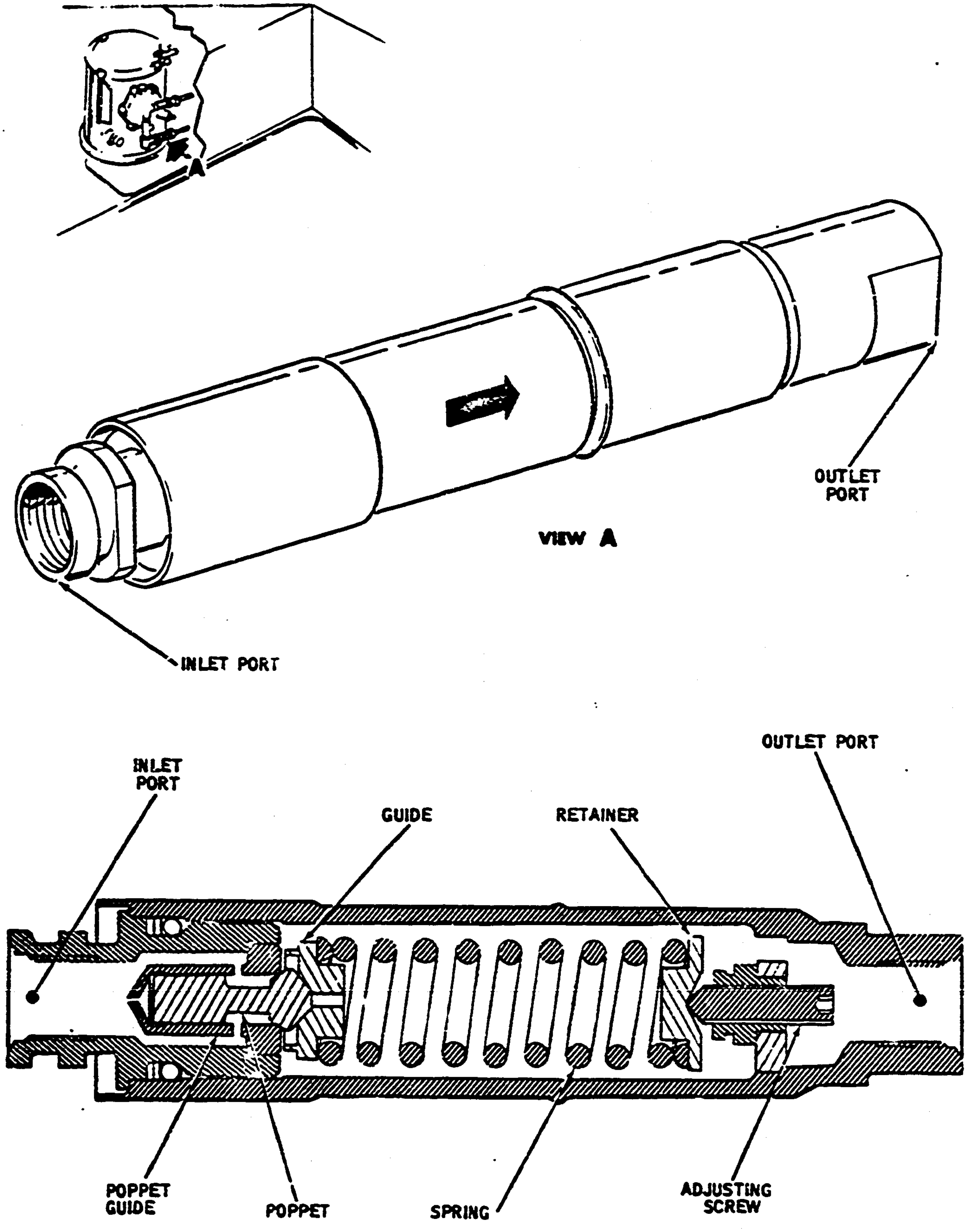
(2) The inlet and outlet ports of the filter are internally threaded and are marked in and out. The filter bowl is cylindrical in shape, with wrench flats at the lower end, and is threaded into the assembly immediately below the ports. A hex-shaped magnetic plug is installed in the drain port. The filter element is stainless steel mesh, supported by a perforated cylindrical center core.

F. Auxiliary Hydraulic System Check Valve

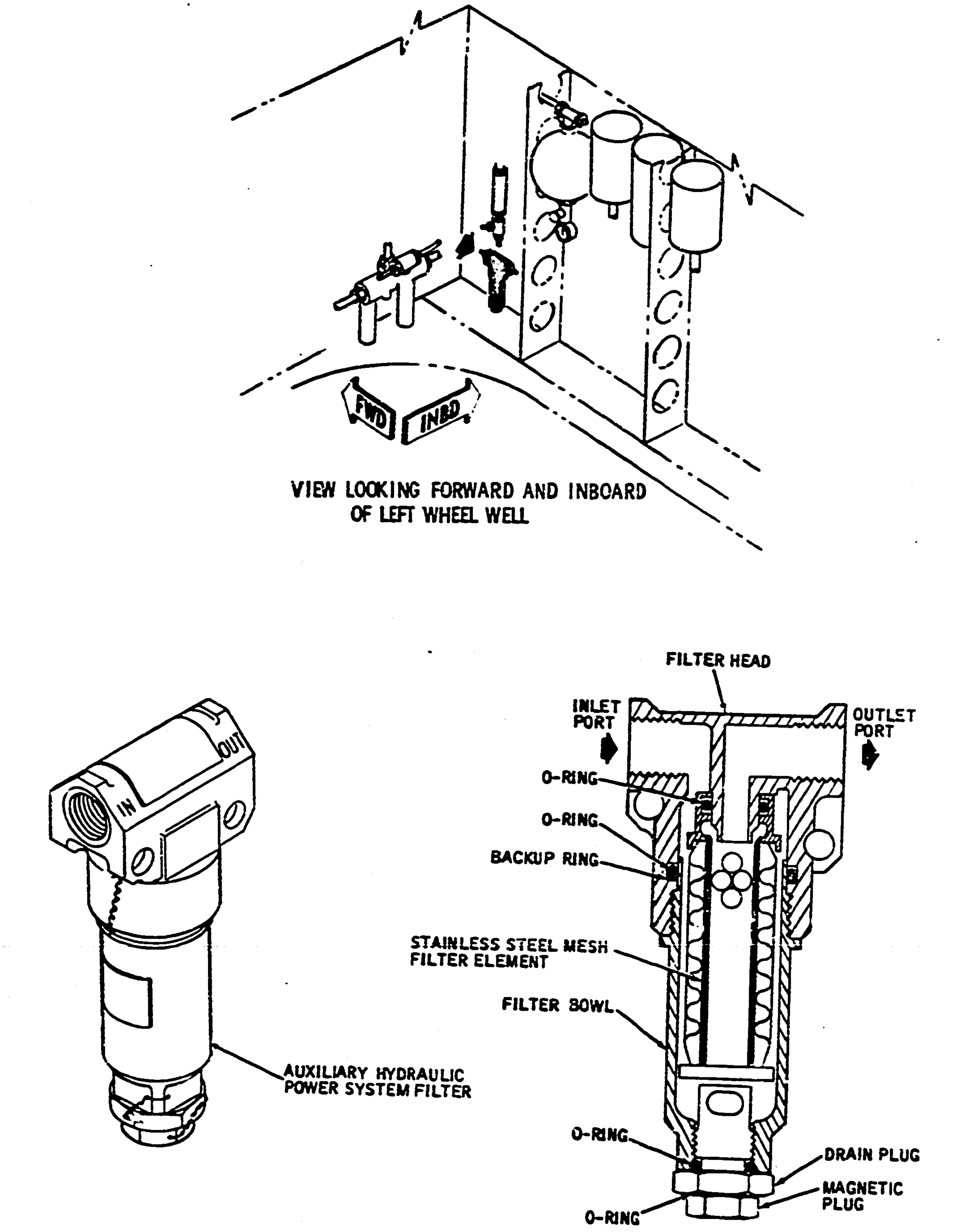
(1) The auxiliary hydraulic system check valve is a spring-loaded, poppet-type valve with a rated capacity of 3000 psi. This valve is installed in the line between the auxiliary hydraulic system filter and the system selector valve to prevent reverse flow of hydraulic fluid through the filter and the auxiliary pump when the engine-driven pumps or external pressure supply are used.

(2) The auxiliary hydraulic system check valve is located in the left wheel well, just above the dual filter and relief valve. The auxiliary hydraulic system check valve is accessible through the left wheel well.

(3) Externally and internally, this valve is similar to the engine-driven hydraulic pump check valve, except for size.



Auxiliary Hydraulic Pump Relief
Valve -- Cutaway View
Figure 3



Auxiliary Hydraulic System Filter -- Cutaway View
Figure 4

G. Auxiliary Hydraulic System Surge Damper Accumulator (See Figure 5.)

(1) The auxiliary hydraulic system surge damper accumulator consists of two spherical domes, separated by a diaphragm and held together by a ring nut. An air filler valve and gage are installed on the accumulator. The accumulator is installed in the auxiliary hydraulic pump pressure line just inboard and aft of the auxiliary pump, and is attached to the shear web by two clamp blocks. Access to the accumulator is through the left wing root access door.

(2) The accumulator is initially charged to 1000 psi with dry nitrogen. As the auxiliary system pressure builds up, fluid is forced against the diaphragm in the accumulator, further compressing the trapped nitrogen in the air side of the accumulator to full system pressure (2600 to 3000 psi is indicated on the accumulator pressure gage). The air in the accumulator absorbs the initial shock of the auxiliary pump output and permits the system pressure to rise gradually. The accumulator also serves to cushion the piping and system components against high impact loads.

H. Auxiliary Hydraulic Pump Control

(1) The auxiliary hydraulic pump control system consists of auxiliary hydraulic pump control switch, an auxiliary hydraulic pump control relay, an auxiliary hydraulic pump power relay, an electric motor, and an auxiliary pump on indicating light.

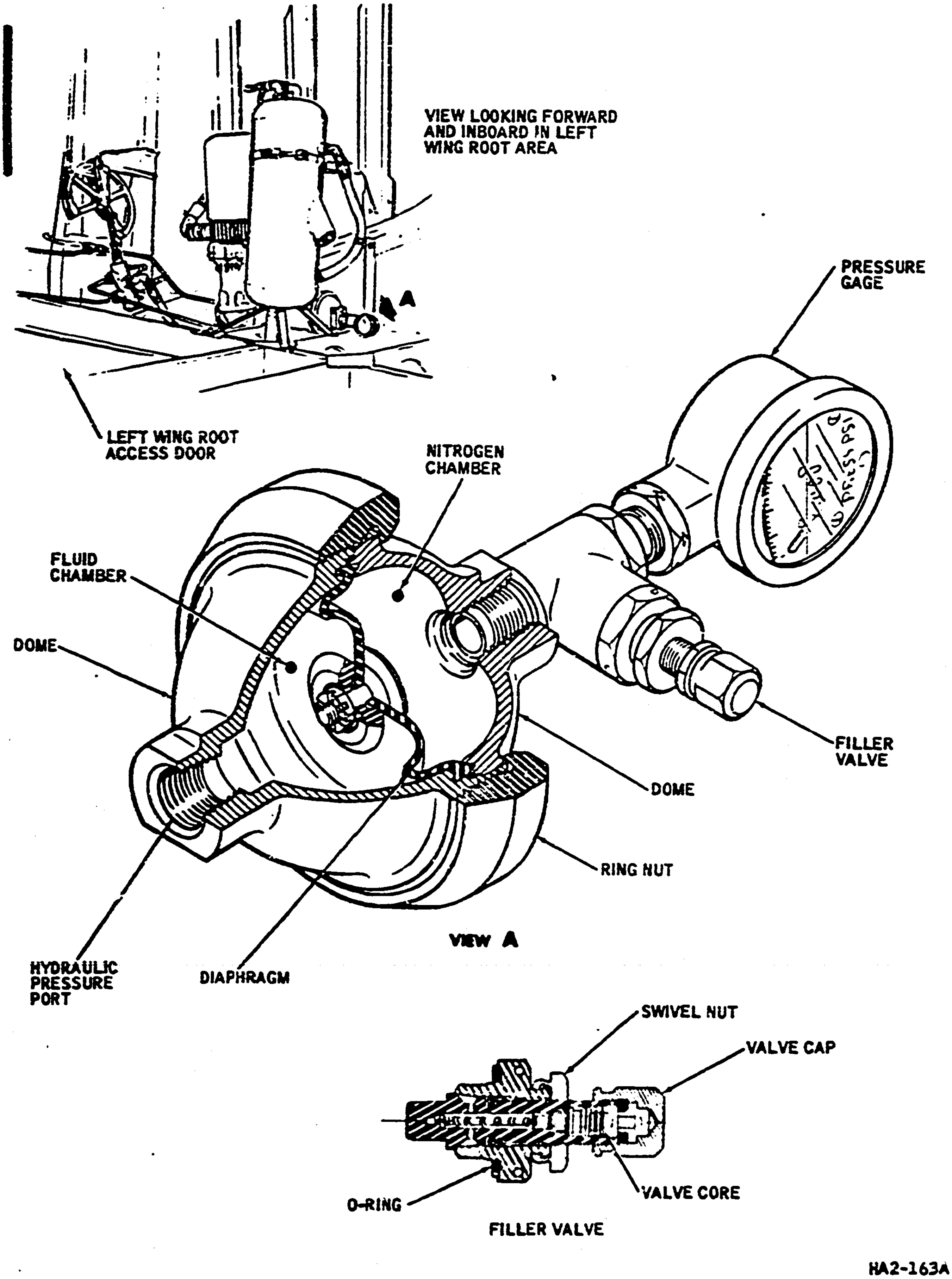
(2) The auxiliary hydraulic pump control switch(es), located in the flight compartment, are 3-position switches. They are spring-loaded to the center position and have two momentary positions placarded start (hold only in emergency) and stop.

(3) The electric motor for the auxiliary hydraulic pump is an ac, 3-phase motor. A thermostatic switch is included in the circuit to protect the motor from overheating.

(4) The auxiliary hydraulic pump motor is supplied with power from the cabin bus 4. This permits pump operation from an external power source or from the airplane electrical system.

(5) The auxiliary pump on indicating light is a blue press-to-test light, located adjacent to the auxiliary hydraulic pump control switch. The light is equipped with a dimming feature.

(6) When the auxiliary hydraulic pump control switch is momentarily moved to the start position, the circuitry is completed between the auxiliary hydraulic pump control relay and cabin bus 4. The ground is through the stop contact of the switch and the thermostatic switch of the motor. Once the relay is energized, it remains energized through its own holding contacts. Through a closed contact of the pump control relay, power is supplied from cabin bus 4 to energize the hydraulic pump power relay.



Auxiliary Hydraulic Power System Surge Damper
Accumulator -- Cutaway View
Figure 5

Through the closed contacts of the pump power relay, a power circuit is completed from the feeder leads of cabin bus 4 to the auxiliary hydraulic pump motor. The blue indicating light, located on the overhead switch panel, receives power through one of the closed contacts of the pump power relay. Therefore, the light is on whenever the pump power relay is energized.

(7) The auxiliary hydraulic pump motor is safeguarded against overheating by the thermostatic switch. Under normal conditions, this switch is in the ground leg of the control relay. When an overheat condition occurs, the thermostatic switch opens the control relay circuit to limit the motor case to 450°F (252°C). This action deenergizes the control relay, which in turn deenergizes the power relay. In an emergency situation, the thermostatic switch can be overridden by holding the auxiliary hydraulic pump control switch in the start (hold only in emergency) position.

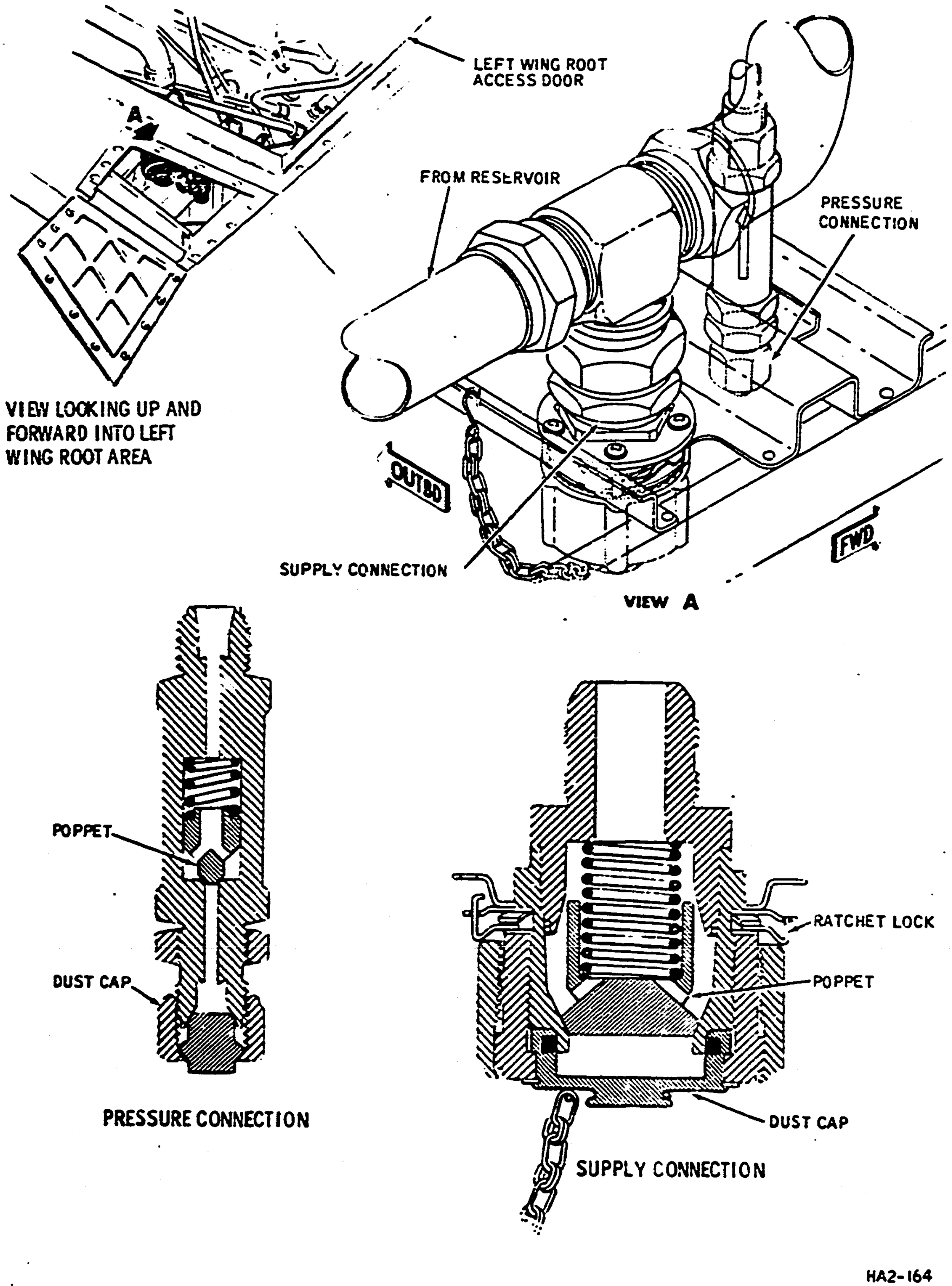
(8) When the auxiliary hydraulic pump control switch is placed in the momentary stop position, the ground for the control relay is broken, deenergizing the power relay and removing power from the pump motor and the indicating light.

I. Ground Service Pressure and Supply Connectors. (See Figure 6.)

(1) The ground service pressure and supply connectors are external fittings to which a service unit can be connected for operating the hydraulic power system when there is no power on the airplane. The connectors are located on a panel covered by an access door on the lower skin of the left wing root, aft of the rear spar.

(2) The ground service pressure connector is made up of a check valve with a flared, bulkhead-type fitting on the inlet end and a standard tube fitting on the outlet end which connects to the left engine-driven pump pressure line. The inlet fitting is covered with a dust cap when not in use.

(3) The internal description of the connector is the same as that of the engine-driven hydraulic pump check valve (see 29-10-0, Description and Operation). The connector operates as a shutoff valve when the ground unit is not connected. When a ground hydraulic power source is connected to the pressure connector and pressure is applied, the poppet unseats and supplies pressure fluid to the hydraulic power system.



Ground Power Connectors -- Cutaway View
Figure 6

(4) The supply connector is made up of a T-fitting and a self-sealing coupling half. The tee is female-threaded to accept the bulkhead-type fitting on the upper end of the coupling. The cross arms of the tee tie into the right engine-driven pump supply line with flared-type fittings. The tee is threaded onto the coupling half and is secured with a locknut. The coupling consists of a coupling body, male-threaded to accept the coupling half from the ground source. The mounting flange has a recess to accept the hex portion of the coupling body, and has notches to retain the lockspring. A dust cap consisting of a union nut assembly, a dust plug, and a securing chain is installed on the lower end of the coupling when not in use.

AUXILIARY - DESCRIPTION AND OPERATION

1. General

A. The auxiliary hydraulic system is a supplementary hydraulic power system connected to the main hydraulic power system through the system selector valve and the auxiliary pump supply selector valve. The auxiliary hydraulic system consists of an electrically driven auxiliary hydraulic pump, an auxiliary pump relief valve, a surge damper accumulator, an auxiliary filter and check valve, and the piping required to interconnect the components and connect the auxiliary system to the main power system.

B. In flight, the auxiliary hydraulic system can be used as supplemental power for the main power system. The auxiliary pump will also serve, when ground support equipment is not available, to pressurize the hydraulic power system for ground testing of the airplane hydraulic subsystems and components. Fluid is supplied to the auxiliary pump from a low standpipe in the hydraulic system reservoir. When the auxiliary pump is operated, fluid from the pressure outlet port of the auxiliary pump is ported, through the auxiliary power system filter and an auxiliary system check valve, to the auxiliary pressure inlet port of the system selector valve. When the system selector valve is in the normal position, auxiliary pump pressure is ported to the general system.

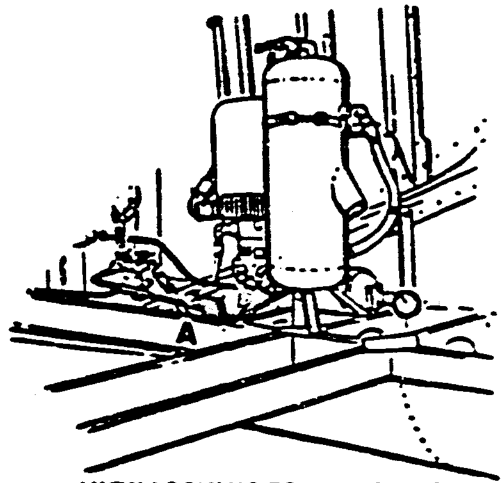
C. When the auxiliary pump is not operating, the auxiliary system check valve prevents reverse flow through the auxiliary pump from the engine-driven pumps. An auxiliary pump relief valve is teed into the line from the auxiliary pump outlet port to the reservoir filter inlet port. The valve relieves and ports excess fluid pressure back to the reservoir if auxiliary pressure builds above 3300 psi.

D. The auxiliary pump alternate reservoir is installed in the auxiliary hydraulic system to provide an alternate hydraulic fluid source in case of depletion of the normal supply in the hydraulic system reservoir. The alternate reservoir source is selectable by operation of the auxiliary hydraulic pump supply selector valve which actuates simultaneously with the hydraulic system selector valve.

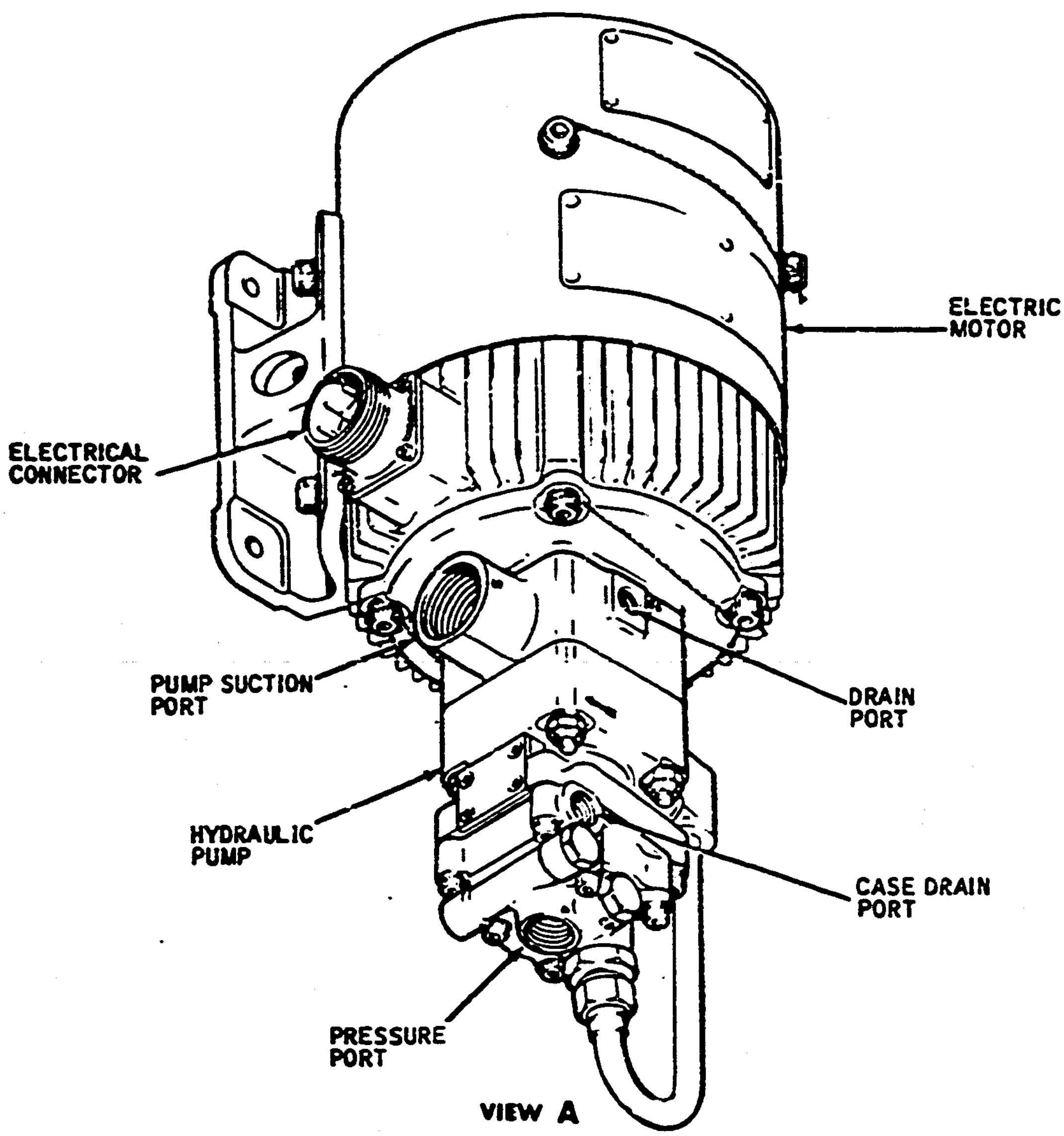
2. System Components

A. Auxiliary Hydraulic Pump (See Figure 1.)

(1) The auxiliary hydraulic pump, located in the left wing root access area, supplies hydraulic pressure for the auxiliary hydraulic system. The pump consists of an air cooled electric motor directly coupled through a shaft and centrifugal boost pump impeller to a variable displacement hydraulic pump.



VIEW LOOKING FORWARD AND INBOARD AT LEFT WING ROOT AREA



VIEW A

HA2-3547

Auxiliary Hydraulic Pump
Figure 1

(2) The electric motor is a 115/200-volt, 3-phase, 400-cps, continuous duty motor rated at 6.5 hp at 11,300 rpm. The motor rotor has an internally splined output shaft which fits on the externally splined input shaft of the pump. The other end of the rotor shaft drives a cooling fan which forces cooling air between the motor case and the outer shroud. A thermoswitch located in the motor case is provided to shut off the motor in case of an overheat condition. An override function of the control switch in the flight compartment is provided to override the thermoswitch for emergency operation.

(3) The centrifugal boost pump impeller is located on the drive shaft between the motor and the variable displacement pump. The impeller draws hydraulic fluid from the system and supplies it through an external tube to the inlet port of the variable displacement pump under pressure, thereby helping to prevent cavitation of the pump.

(4) The variable displacement hydraulic pump consists of the following major parts: a four piece housing, drive shaft with impeller, axial cylinder barrel containing 9 pistons, pivoting hanger with an inclined camface, hold down plate, pressure compensating valve, and bearings.

(5) When the electric motor is actuated, the drive shaft rotates the boost pump impeller and the cylinder and piston group. Each revolution of the cylinder causes one complete stroke of each piston. The pistons are held against the camface of the hanger by the hold down plate, providing positive piston return. The displacement of fluid from the pump discharge port is controlled by the compensator valve. The pump provides full flow of 3.9 gpm at system pressures up to approximately 2700 psi. At this point, the compensator valve reduces flow until at approximately 3000 psi, displacement of fluid is reduced to zero.

B. Auxiliary Hydraulic Pump Alternate Reservoir

(1) The auxiliary hydraulic pump alternate reservoir is installed on the shear web in the left wing root area immediately aft of the auxiliary hydraulic pump. Access to the reservoir is through the left wing root access door. The alternate reservoir supplies hydraulic fluid to the auxiliary hydraulic pump in the event the fluid supply from the main hydraulic system reservoir is exhausted.

(2) The reservoir is cylindrical in shape and has a fluid capacity of approximately 1.9 US gallons (1.6 Imperial gallons or 7.3 liters). There are four ports on the reservoir: an outlet port to the auxiliary hydraulic pump selector valve located at the bottom, an inlet port from the auxiliary hydraulic pump case drain located near the top on the side, an inlet from the wing flap return line, and an outlet to the main hydraulic reservoir located at the top. A sight gage is installed near the top of the reservoir for visual indication of fluid level, and a mounting boss for the emergency hydraulic level indicating light switch is installed on the side of the reservoir.

(3) The reservoir is kept full during operation by routing fluid from the wing flap return line to the reservoir. Fluid in excess of the alternate reservoir capacity is then routed to the main hydraulic system reservoir capacity is then routed to the main hydraulic system reservoir. Hydraulic fluid from the auxiliary pump case drain is routed to the alternate reservoir and then to the main reservoir. Fluid is used from the alternate reservoir only when the auxiliary pump is operating and the auxiliary pump supply selector valve is in the alternate position. Fluid supply to the alternate reservoir is replenished whenever the wing flaps are operated.

C. Auxiliary Hydraulic Pump Supply Selector Valve (See Figure 2.)

(1) The auxiliary hydraulic pump supply valve is a 2-position valve that ports hydraulic fluid from either reservoir, through a common outlet, to the auxiliary pump. The selector valve is located on the shear web in the left wing root, near the auxiliary pump. The selector valve is accessible through the left wing root access door.

(2) The valve body has two inlet ports and one outlet port. The outlet port is centrally located on the aft side of the valve body. The two inlet ports are located on the outboard side of the valve body, 90 degrees from the outlet port. Two mounting flanges are located on the inboard side of the valve body. These flanges are an integral part of the valve body.

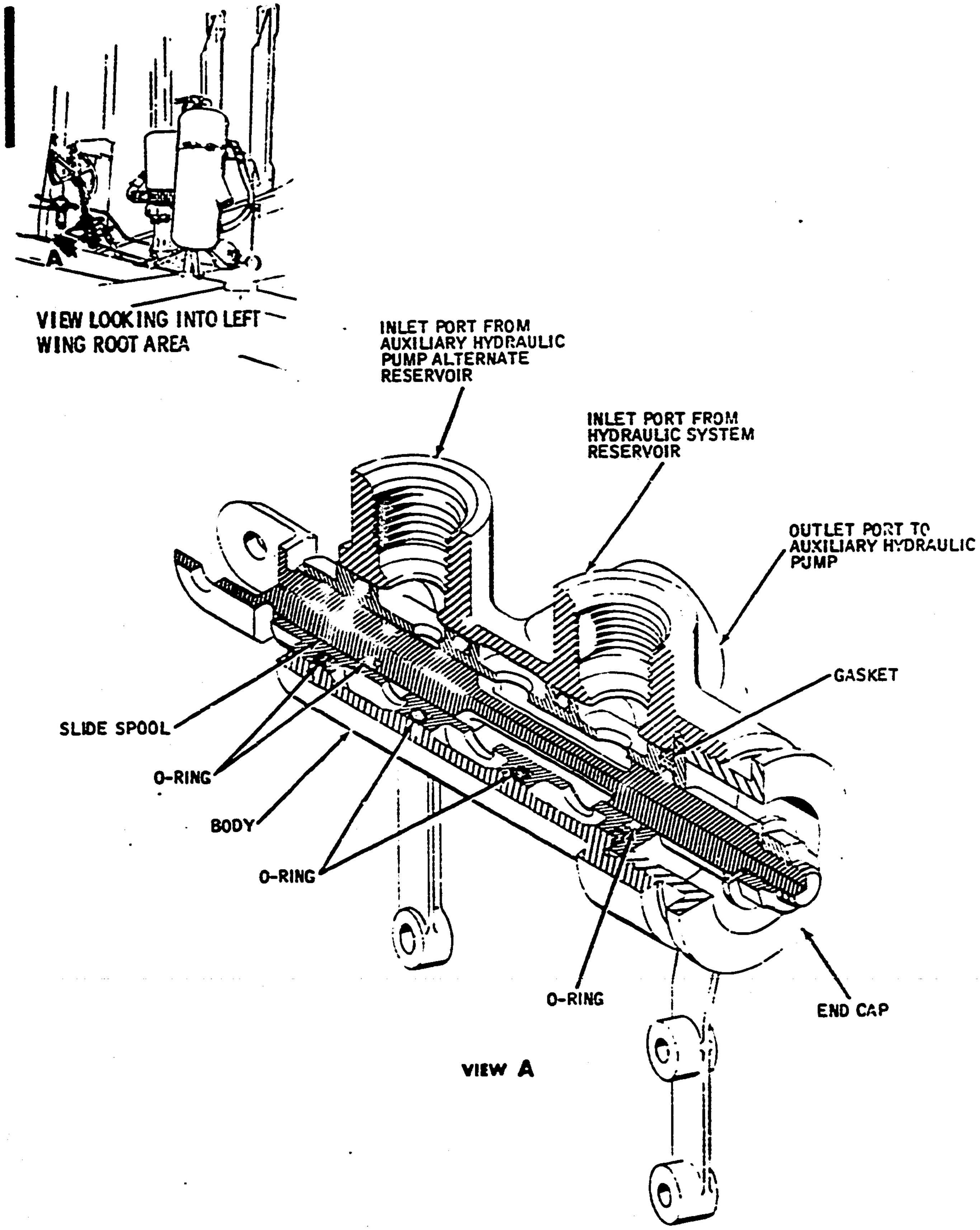
(3) During normal operation, fluid is taken from a low standpipe in the main hydraulic system reservoir and ported to the auxiliary pump. When the valve is in the alternate position, fluid is taken from the auxiliary hydraulic pump alternate reservoir and ported to the auxiliary pump. The valve is moved from the auxiliary position to the alternate position by placing the hydraulic system selector control lever, located on the system engineer's control pedestal, to the general system/main gear downlock and flaps position.

D. Auxiliary Hydraulic Pump Relief Valve (See Figure 3.)

(1) The auxiliary hydraulic pump relief valve is a spring loaded poppet-type valve and serves to relieve excess fluid pressure that may build up in the auxiliary hydraulic system. The relief valve connects, through a reducer, to a tee in the A return port of the hydraulic system reservoir. The valve is accessible through the left wing root access door.

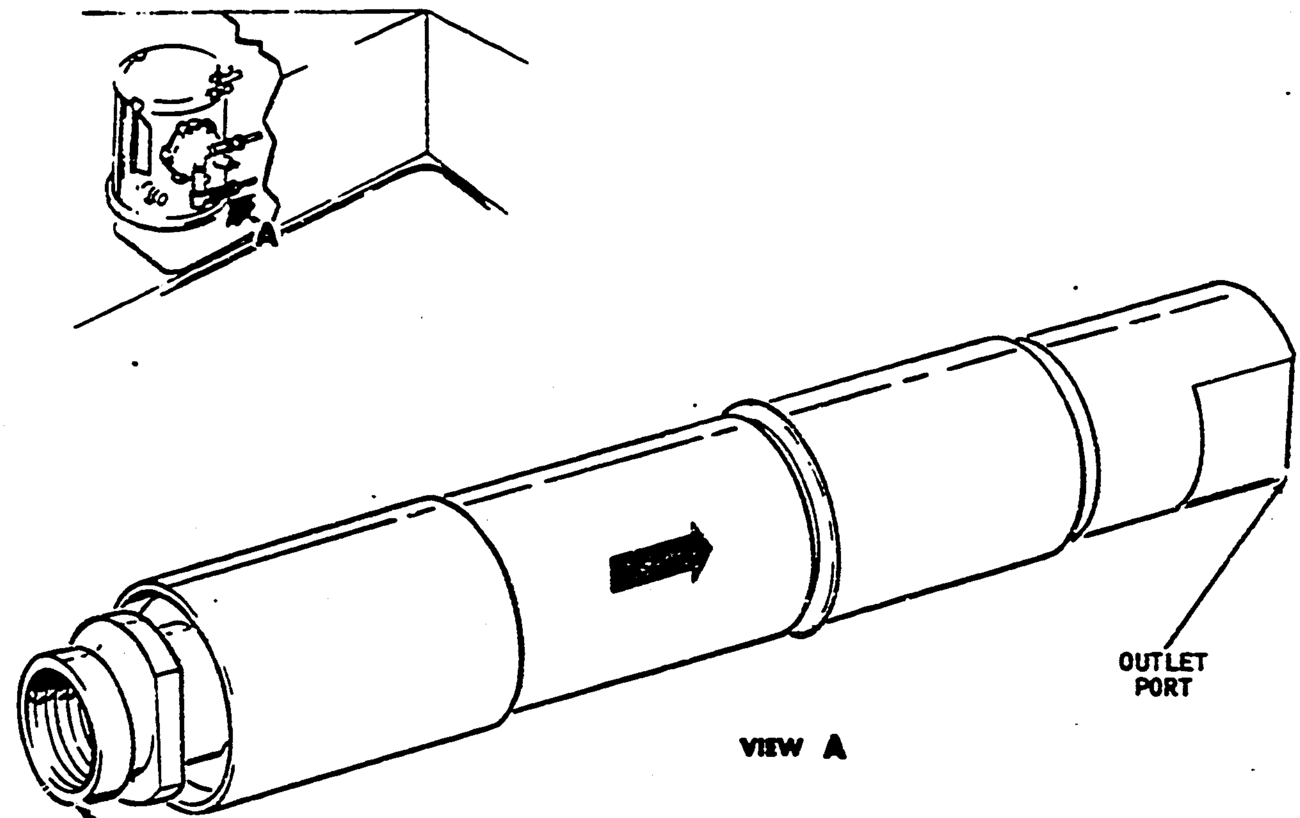
(2) Externally, the valve body is cylindrical, approximately 5 inches in length, and 1 inch in diameter. The outlet end of the valve is slightly larger than the inlet end.

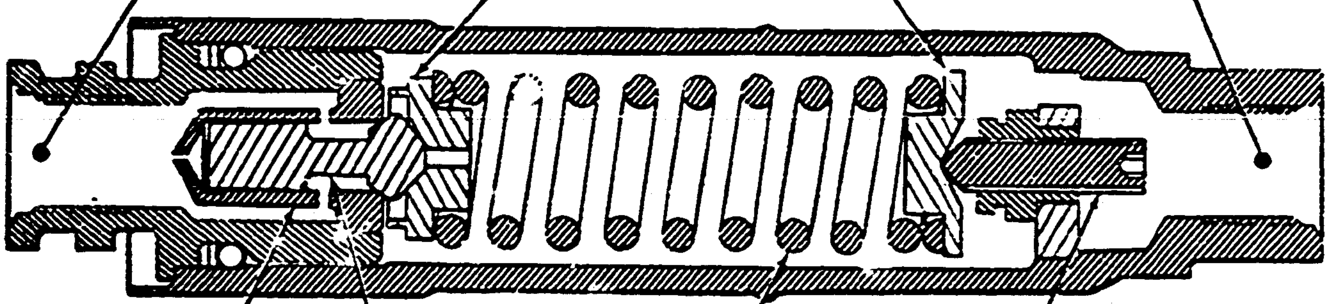
(3) When pressure builds up, the poppet starts to relieve at approximately 3300 psi. If pressure continues to build up, the poppet continues to open until 3500 psi and a maximum flow of 3.5 gpm are reached. When pressure is relieved, the poppet reseats at 90 percent of the unseat pressure.



HA2-160A

Auxiliary Hydraulic Pump Supply Selector
Valve -- Cutaway View
Figure 2





HA2-161

Auxiliary Hydraulic Pump Relief Valve -- Cutaway View
Figure 3

E. Auxiliary Hydraulic System Filter (See Figure 4.)

(1) A line-type, 10 micron filter assembly is installed in the piping of the auxiliary system to filter fluid from the pressure outlet port of the auxiliary pump to the system selector valve. The filter is located on the bulkhead near the forward inboard corner of the left main gear wheel well, slightly inboard and above the dual filter and relief valve. It is accessible through the left main gear inboard door.

(2) The inlet and outlet ports of the filter are internally threaded and are marked in and out. The filter bowl is cylindrical in shape, with wrench flats at the lower end, and is threaded into the assembly immediately below the ports. A hex-shaped magnetic plug is installed in the drain port. The filter element is stainless steel mesh, supported by a perforated cylindrical center core.

F. Auxiliary Hydraulic System Check Valve

(1) The auxiliary hydraulic system check valve is a spring-loaded, poppet-type valve with a rated capacity of 3000 psi. This valve is installed in the line between the auxiliary hydraulic system filter and the system selector valve to prevent reverse flow of hydraulic fluid through the filter and the auxiliary pump when the engine-driven pumps or external pressure supply are used.

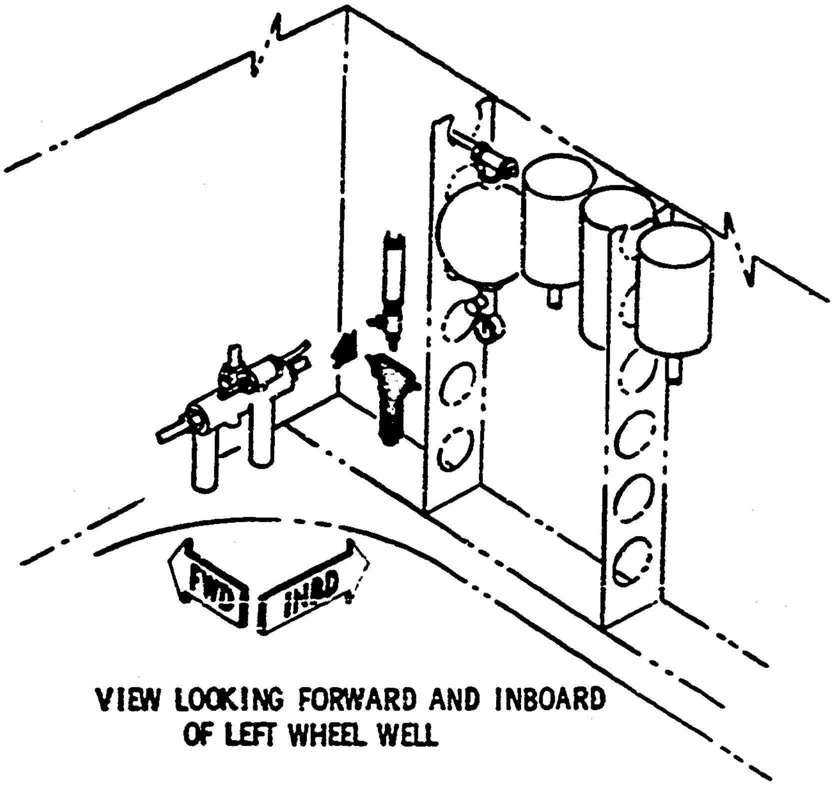
(2) The auxiliary hydraulic system check valve is located in the left wheel well, just above the dual filter and relief valve. The auxiliary hydraulic system check valve is accessible through the left wheel well.

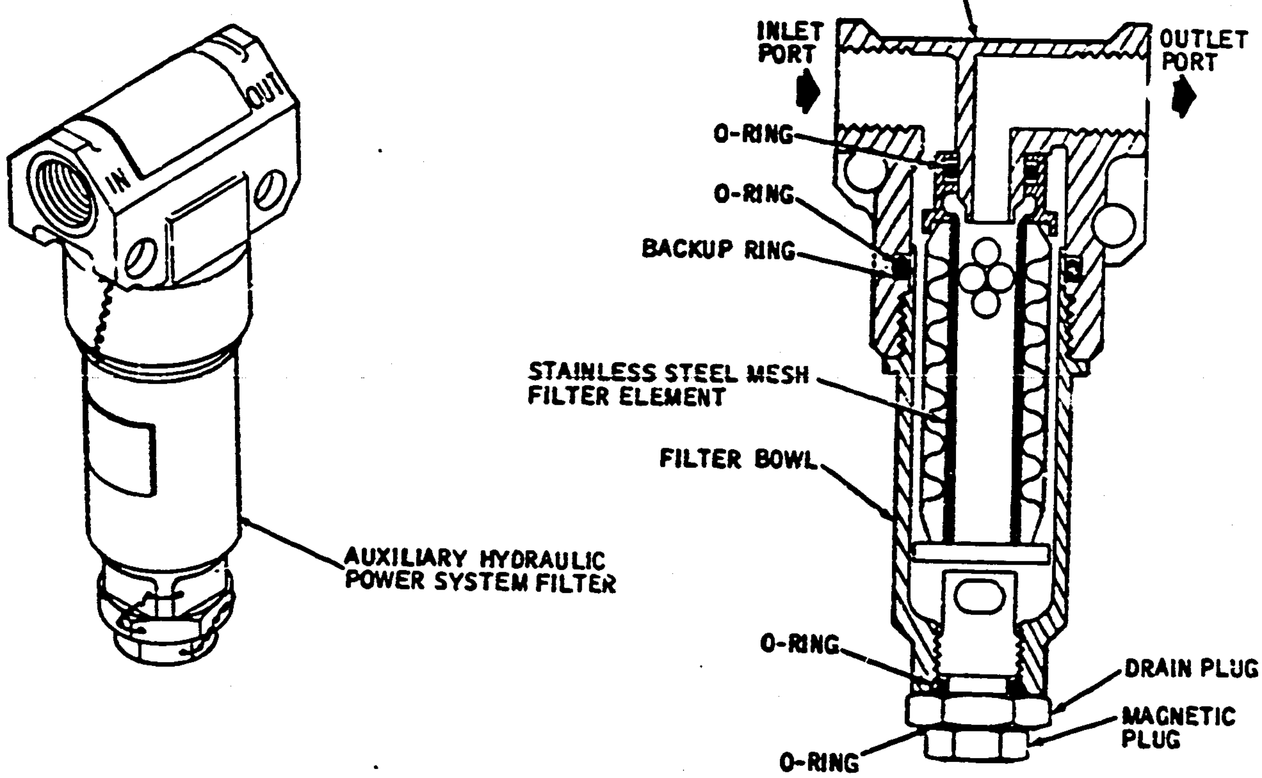
(3) Externally and internally, this valve is similar to the engine-driven hydraulic pump check valve, except for size.

G. Auxiliary Hydraulic System Surge Damper Accumulator (See Figure 5.)

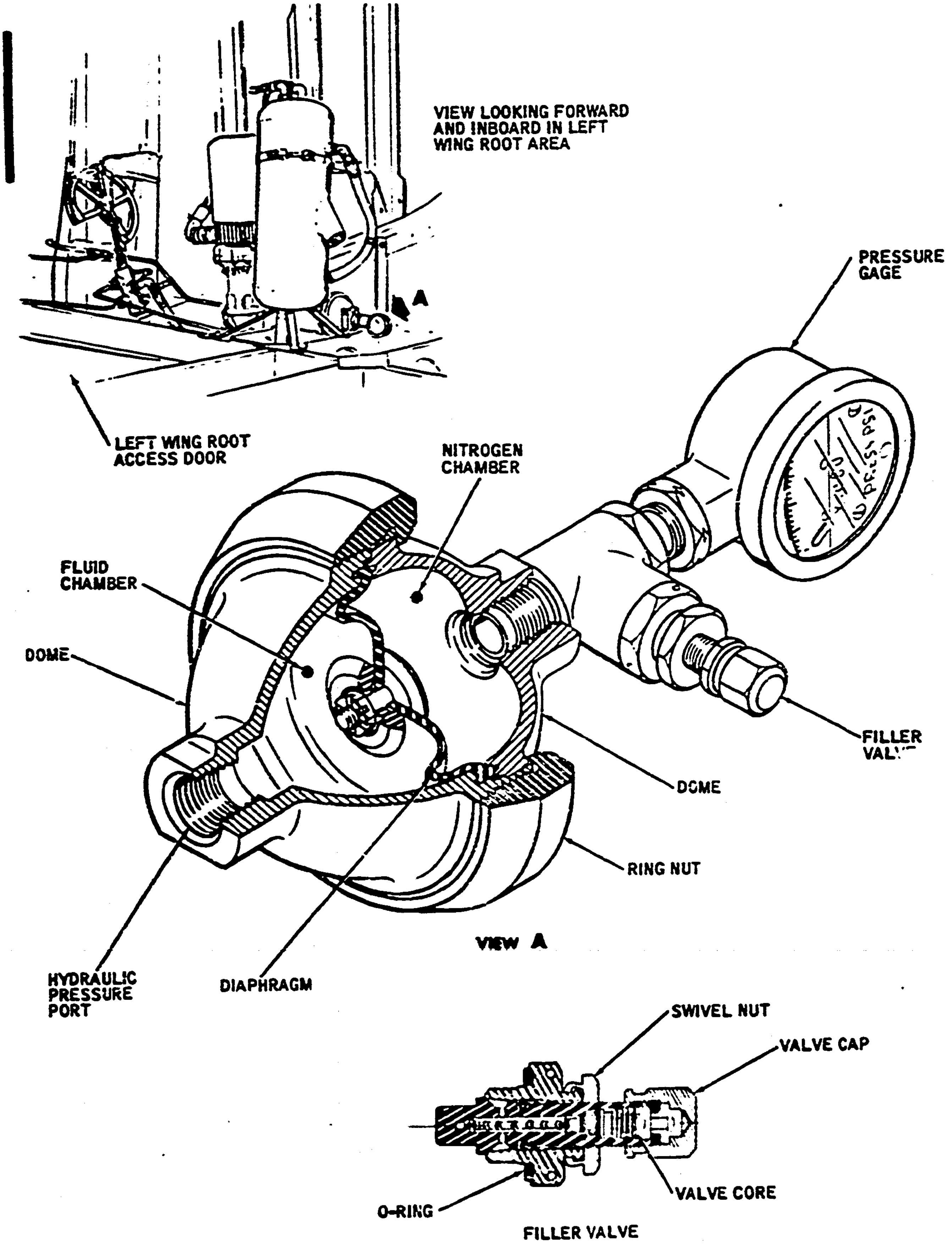
(1) The auxiliary hydraulic system surge damper accumulator consists of two spherical domes, separated by a diaphragm and held together by a ring nut. An air filler valve and gage are installed on the accumulator. The accumulator is installed in the auxiliary hydraulic pump pressure line just inboard and aft of the auxiliary pump, and is attached to the shear web by two clamp blocks. Access to the accumulator is through the left wing root access door.

(2) The accumulator is initially charged to 1000 psi with dry nitrogen. As the auxiliary system pressure builds up, fluid is forced against the diaphragm in the accumulator, further compressing the trapped nitrogen in the air side of the accumulator to full system pressure (2600 to 3000 psi is indicated on the accumulator pressure gage). The air in the accumulator absorbs the initial shock of the auxiliary pump output and permits the system pressure to rise gradually. The accumulator also serves to cushion the piping and system components against high impact loads.





Auxiliary Hydraulic System Filter -- Cutaway View
Figure 4



HA2-163A

Auxiliary Hydraulic Power System Surge Damper
Accumulator -- Cutaway View
Figure 5

H. Auxiliary Hydraulic Pump Control

(1) The auxiliary hydraulic pump control system consists of auxiliary hydraulic pump control switch, an auxiliary hydraulic pump control relay, an auxiliary hydraulic pump power relay, an electric motor, and an auxiliary pump on indicating light.

(2) The auxiliary hydraulic pump control switch(es), located in the flight compartment, are 3-position switches. They are spring-loaded to the center position and have two momentary positions placarded start (hold only in emergency) and stop.

(3) The electric motor for the auxiliary hydraulic pump is an ac, 3-phase motor. A thermostatic switch is included in the circuit to protect the motor from overheating.

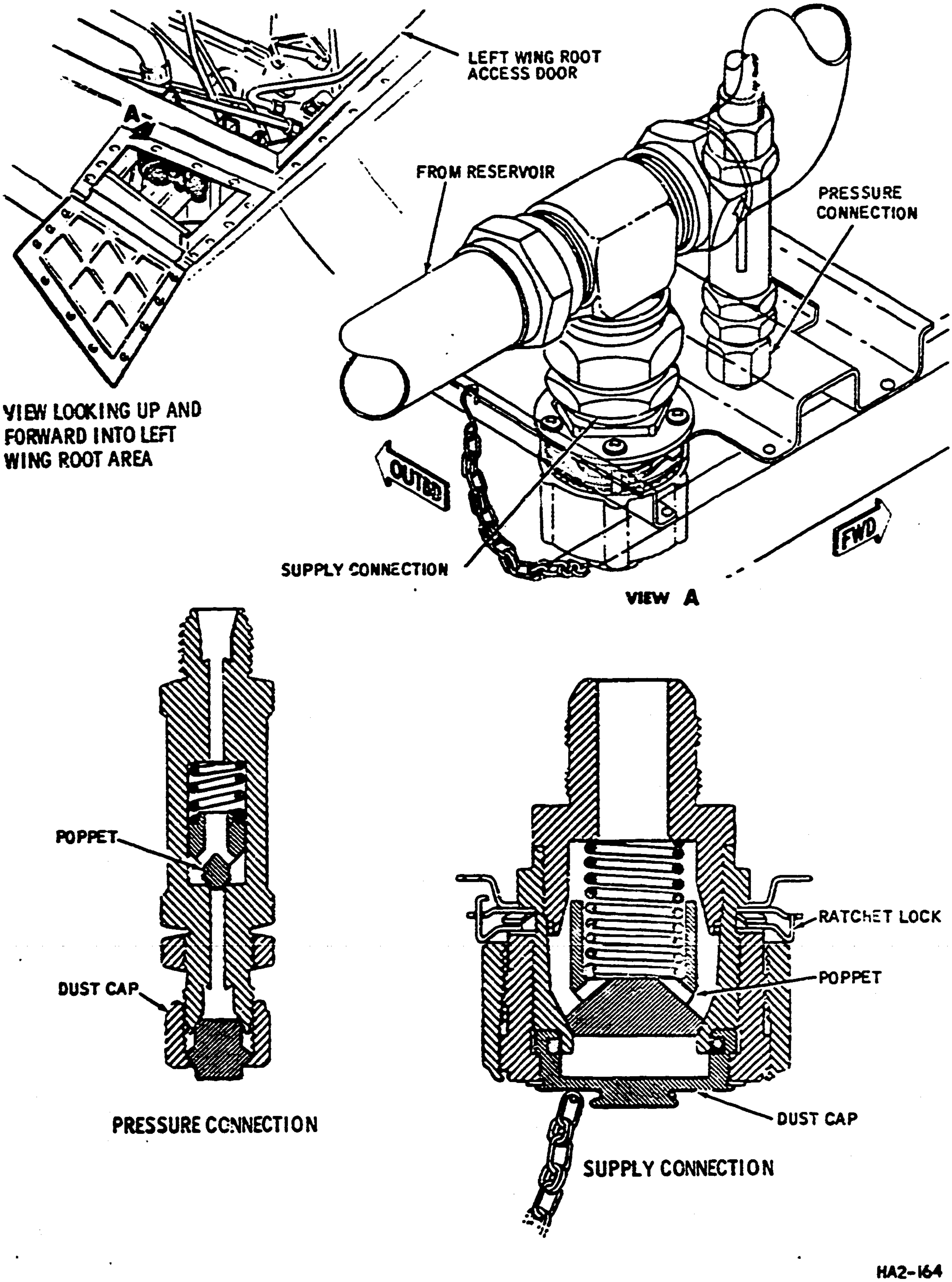
(4) The auxiliary hydraulic pump motor is supplied with power from the cabin bus 4. This permits pump operation from an external power source or from the airplane electrical system.

(5) The auxiliary pump on indicating light is a blue press-to-test light, located adjacent to the auxiliary hydraulic pump control switch. The light is equipped with a dimming feature.

(6) When the auxiliary hydraulic pump control switch is momentarily moved to the start position, the circuitry is completed between the auxiliary hydraulic pump control relay and cabin bus 4. The ground is through the stop contact of the switch and the thermostatic switch of the motor. Once the relay is energized, it remains energized through its own holding contacts. Through a closed contact of the pump control relay, power is supplied from cabin bus 4 to energize the hydraulic pump power relay. Through the closed contacts of the pump power relay, a power circuit is completed from the feeder leads of cabin bus 4 to the auxiliary hydraulic pump motor. The blue indicating light, located on the overhead switch panel, receives power through one of the closed contacts of the pump power relay. Therefore, the light is on whenever the pump power relay is energized.

(7) The auxiliary hydraulic pump motor is safeguarded against overheating by the thermostatic switch. Under normal conditions, this switch is in the ground leg of the control relay. When an overheat condition occurs, the thermostatic switch opens the control relay circuit to limit the motor case to 450°F (252°C). This action deenergizes the control relay, which in turn deenergizes the power relay. In an emergency situation, the thermostatic switch can be overridden by holding the auxiliary hydraulic pump control switch in the start (hold only in emergency) position.

(8) When the auxiliary hydraulic pump control switch is placed in the momentary stop position, the ground for the control relay is broken, deenergizing the power relay and removing power from the pump motor and the indicating light.



Ground Power Connectors -- Cutaway View
Figure 6

I. Ground Service Pressure and Supply Connectors (See Figure 6.)

(1) The ground service pressure and supply connectors are external fittings to which a service unit can be connected for operating the hydraulic power system when there is no power on the airplane. The connectors are located on a panel covered by an access door on the lower skin of the left wing root, aft of the rear spar.

(2) The ground service pressure connector is made up of a check valve with a flared, bulkhead-type fitting on the inlet end and a standard tube fitting on the outlet end which connects to the left engine-driven pump pressure line. The inlet fitting is covered with a dust cap when not in use.

(3) The internal description of the connector is the same as that of the engine-driven hydraulic pump check valve (see 29-10-0 Description and Operation). The connector operates as a shutoff valve when the ground unit is not connected. When a ground hydraulic power source is connected to the pressure connector and pressure is applied, the poppet unseats and supplies pressure fluid to the hydraulic power system.

(4) The supply connector is made up of a T-fitting and a self-sealing coupling half. The tee is female-threaded to accept the bulkhead-type fitting on the upper end of the coupling. The cross arms of the tee tie into the right engine-driven pump supply line with flared-type fittings. The tee is threaded onto the coupling half and is secured with a locknut. The coupling consists of a coupling body, male-threaded to accept the coupling half from the ground source. The mounting flange has a recess to accept the hex portion of the coupling body, and has notches to retain the lockspring. A dust cap consisting of a union nut assembly, a dust plug, and a securing chain is installed on the lower end of the coupling when not in use.

AUXILIARY - DESCRIPTION AND OPERATION

1. General

A. The auxiliary hydraulic system is a supplementary hydraulic power system connected to the main hydraulic power system through the system selector valve and the auxiliary pump supply selector valve. The auxiliary hydraulic system consists of an electrically driven auxiliary hydraulic pump, an auxiliary pump relief valve, a surge damper accumulator, an auxiliary filter and check valve, and the piping required to interconnect the components and connect the auxiliary system to the main power system.

B. In flight, the auxiliary hydraulic system can be used as supplemental power for the main power system. The auxiliary pump will also serve, when ground support equipment is not available, to pressurize the hydraulic power system for ground testing of the airplane hydraulic subsystems and components. Fluid is supplied to the auxiliary pump from a low standpipe in the hydraulic system reservoir. When the auxiliary pump is operated, fluid from the pressure outlet port of the auxiliary pump is ported, through the auxiliary power system filter and an auxiliary system check valve, to the auxiliary pressure inlet port of the system selector valve. When the system selector valve is in the normal position, auxiliary pump pressure is ported to the general system.

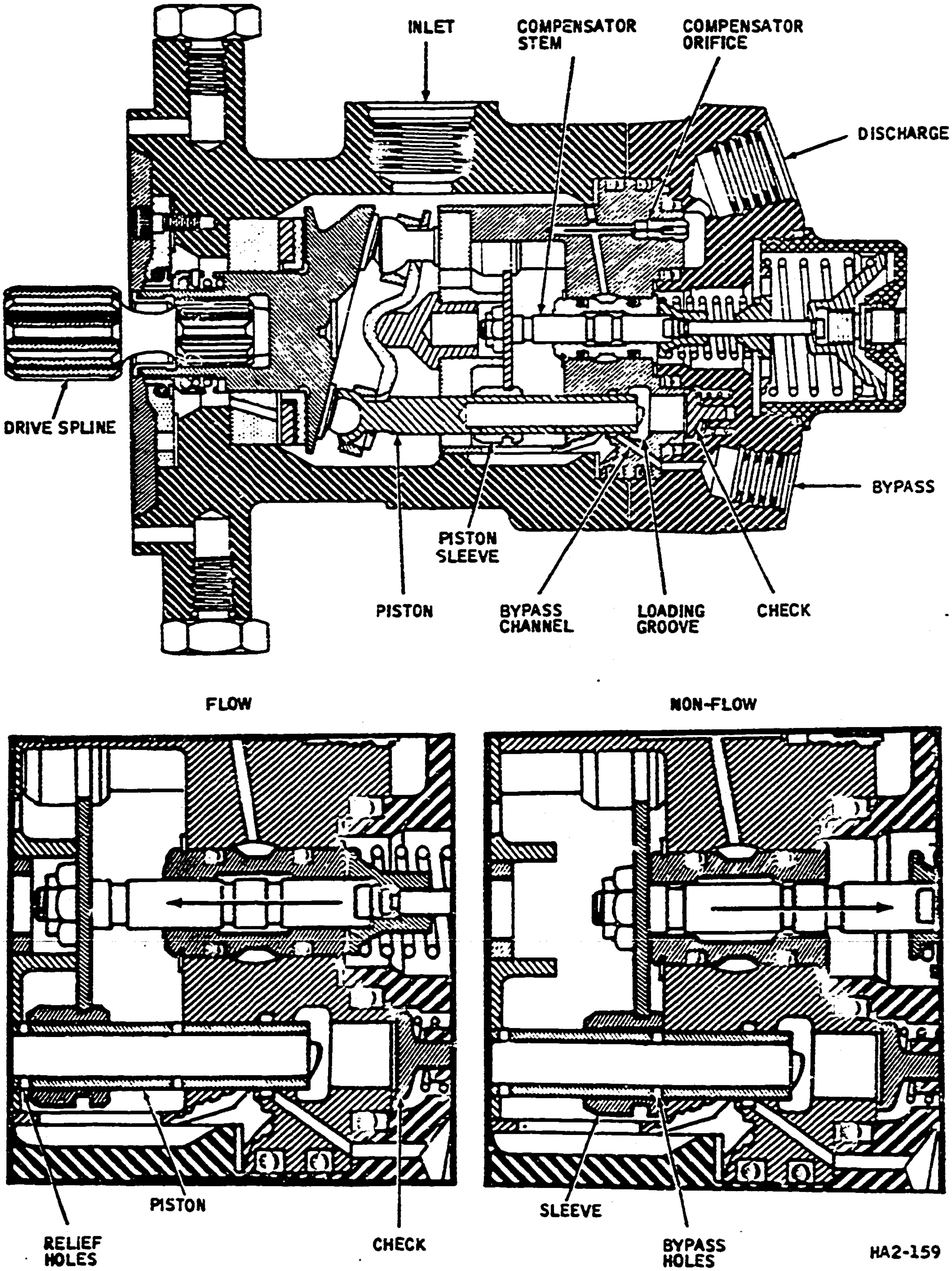
C. When the auxiliary pump is not operating, the auxiliary system check valve prevents reverse flow through the auxiliary pump from the engine-driven pumps. An auxiliary pump relief valve is teed into the line from the auxiliary pump outlet port to the reservoir filter inlet port. The valve relieves and ports excess fluid pressure back to the reservoir if auxiliary pressure builds above 3300 psi.

D. The auxiliary pump alternate reservoir is installed in the auxiliary hydraulic system to provide an alternate hydraulic fluid source in case of depletion of the normal supply to the hydraulic system reservoir. The alternate reservoir source is selectable by operation of the auxiliary hydraulic pump supply selector valve which actuates simultaneously with the hydraulic system selector valve.

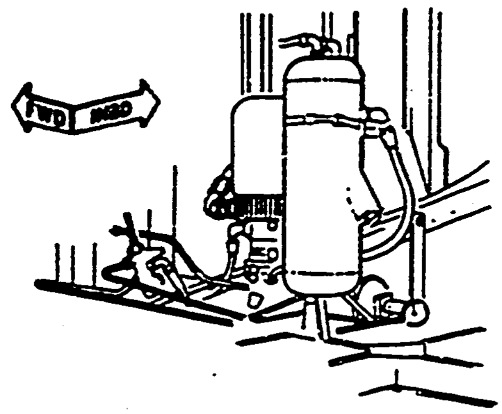
2. System Components

A. Auxiliary Hydraulic Pump (See Figure 1.)

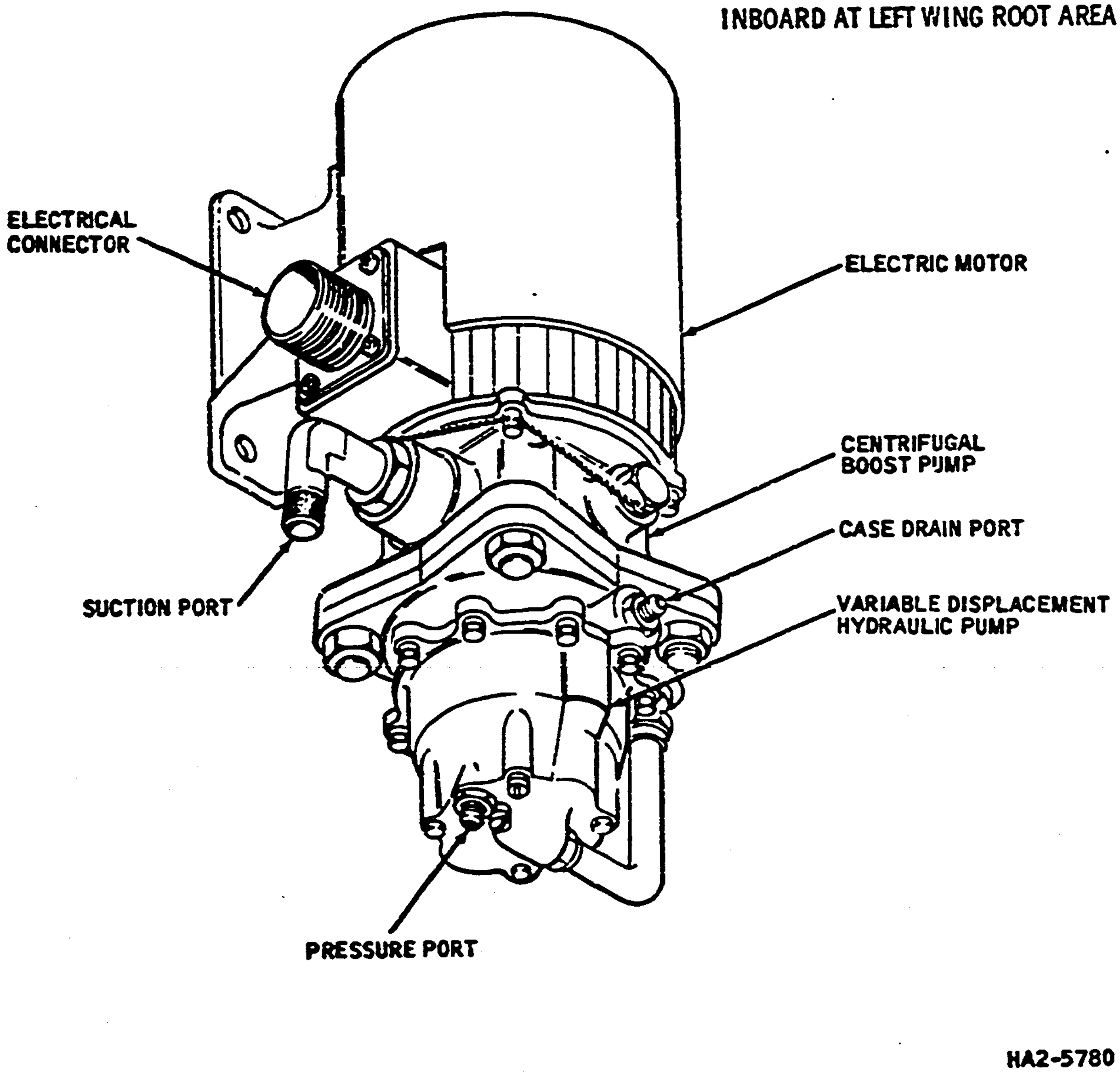
(1) The auxiliary hydraulic pump on airplanes 801-822, 860-866 is an electrically driven, continuous-duty, pressure-compensated, variable-displacement pump located in the left wing root access area. An automatic pressure-sensing mechanism (compensator) within the pump regulates the amount of fluid delivered to the airplane hydraulic system. The quantity of delivery is dependent on the system pressure. Flow is reduced to zero when desired system pressure is achieved.



Auxiliary Hydraulic Pump -- Cutaway View
(Airplanes 801-822, 860-866)
Figure 1 (Sheet 1)



VIEW LOOKING FORWARD AND
INBOARD AT LEFT WING ROOT AREA



HA2-5780

Auxiliary Hydraulic Pump
(Airplanes 867 and Subsequent)
Figure 1 (Sheet 2)

(2) The internal components of the pump perform three major functions; mechanical drive (motor), fluid displacement (pistons), and pressure control (compensator). Mechanical drive is supplied by a 200-vac, 3-phase, 400-cycle electric motor.

(3) As the hydraulic fluid from the reservoir enters the inlet port, the fluid is displaced by axial piston motion. As a piston advances in a cylinder bore, it forces a quantity of fluid past the pump check at the end of the bore. When the piston bypass holes become aligned hydraulically with the cylinder block passage, pressurized fluid also escapes to bypass; then a combination of spring pressure and system back pressure closes the pump checks. In the withdrawal portion of the piston stroke, a partial vacuum is created in the cylinder bore, allowing new fluid from the intake to flow into the bore from the pressurized reservoir. The quantity of fluid delivered by each piston stroke is controlled by relief holes in the pistons and piston sleeves.

(4) Unless the relief holes are covered by the piston sleeves, no fluid is forced past the pump checks. Quantity of delivery is therefore determined by the position of the piston sleeves, which in turn is determined by system pressure bled through the compensator orifices. Because one sleeve is slightly longer than the others, the pump, even when in full cutoff, continues to pump enough fluid to make up for any minor drop in the system pressure due to leakage.

(5) Pressure control: System pressure, acting through the compensator orifice on the compensator stem, controls the piston sleeve position and, therefore, determines whether the pump delivers at full capacity, partial capacity, or cuts off entirely. Path of fluid flow through the pump remains the same in all three conditions. When the pressure at the outlet port reaches 2700 psi, pressure in the compensator commences to reduce the output until 3000 psi is reached, at which time fluid flow is zero. The bypass system is provided to supply self-lubrication, particularly when the pump is in non-delivery (cutoff) operation. The ring of bypass holes in the pistons is hydraulically aligned with the bypass passage each time a piston reaches the very end of its forward travel period. This pumps a small quantity of fluid out the bypass passage back to the supply reservoir and provides a constant changing of the fluid in the pump. The bypass is designed to pump against a considerable back pressure for use with pressurized hydraulic reservoirs.

(6) On airplanes 867 and subsequent, the auxiliary hydraulic pump, located in the left wing root access area, supplies hydraulic pressure for the auxiliary hydraulic system. The pump consists of an air cooled electric motor directly coupled through a shaft and centrifugal boost pump impeller to a variable displacement hydraulic pump.

(7) The electric motor is a 115/200-volt, 3-phase, 400-cps, continuous duty motor. The motor rotor has an internally splined output shaft which fits on the externally splined input shaft of the pump. The other end of the rotor shaft drives a cooling fan which forces cooling air between

the motor case and the outer shroud. A thermoswitch located in the motor case is provided to shut off the motor in case of an overheat condition. An override function of the control switch in the flight compartment is provided to override the thermoswitch for emergency operation.

(8) The centrifugal boost pump impeller is located on the drive shaft between the motor and the variable displacement pump. The impeller draws hydraulic fluid from the system and supplies it through an external tube to the inlet port of the variable displacement pump under pressure, thereby helping to prevent cavitation of the pump.

(9) The variable displacement hydraulic pump consists of the following major parts: a four piece housing, drive shaft with impeller, axial cylinder barrel containing 9 pistons, pivoting hanger with an inclined camface, hold down plate, pressure compensating valve, and bearings.

(10) When the electric motor is actuated, the drive shaft rotates the boost pump impeller and the cylinder and piston group. Each revolution of the cylinder causes one complete stroke of each piston. The pistons are held against the camface of the hanger by the hold down plate, providing positive piston return. The displacement of fluid from the pump discharge port is controlled by the compensator valve. The pump provides full flow of 3.7 gpm at system pressures up to approximately 2700 psi. At this point, the compensator valve reduces flow until at approximately 3000 psi, displacement of fluid is reduced to zero.

B. Auxiliary Hydraulic Pump Alternate Reservoir

(1) The auxiliary hydraulic pump alternate reservoir is installed on the shear web in the left wing root area, immediately aft of the auxiliary hydraulic pump. Access to the reservoir is through the left wing root access door. The alternate reservoir supplies hydraulic fluid to the auxiliary hydraulic pump in the event the fluid supply from the main hydraulic system reservoir is exhausted.

(2) The reservoir is cylindrical in shape and has a fluid capacity of approximately 1.9 US gallons (1.6 Imperial gallons or 7.3 liters).

There are four ports on the reservoir: an outlet port to the auxiliary hydraulic pump selector valve located at the bottom, an inlet port from the auxiliary hydraulic pump bypass located near the top on the side, an inlet from the wing flap return line, and an outlet to the main hydraulic reservoir located at the top. A sight gage is installed near the top of the reservoir for visual indication of fluid level, and a mounting boss for the emergency hydraulic level indicating light switch is installed on the side of the reservoir.

(3) The reservoir is kept full during operation by routing fluid from the wing flap return line to the reservoir. Fluid in excess of the alternate reservoir capacity is then routed to the main hydraulic system reservoir. Hydraulic fluid from the auxiliary pump bypass is routed to the alternate reservoir and then to the main reservoir. Fluid is used from the alternate reservoir only when the auxiliary pump is operating and the auxiliary pump supply selector valve is in the alternate position. Fluid supply to the alternate reservoir is replenished whenever the wing flaps are operated.

C. Auxiliary Hydraulic Pump Supply Selector Valve (See Figure 2.)

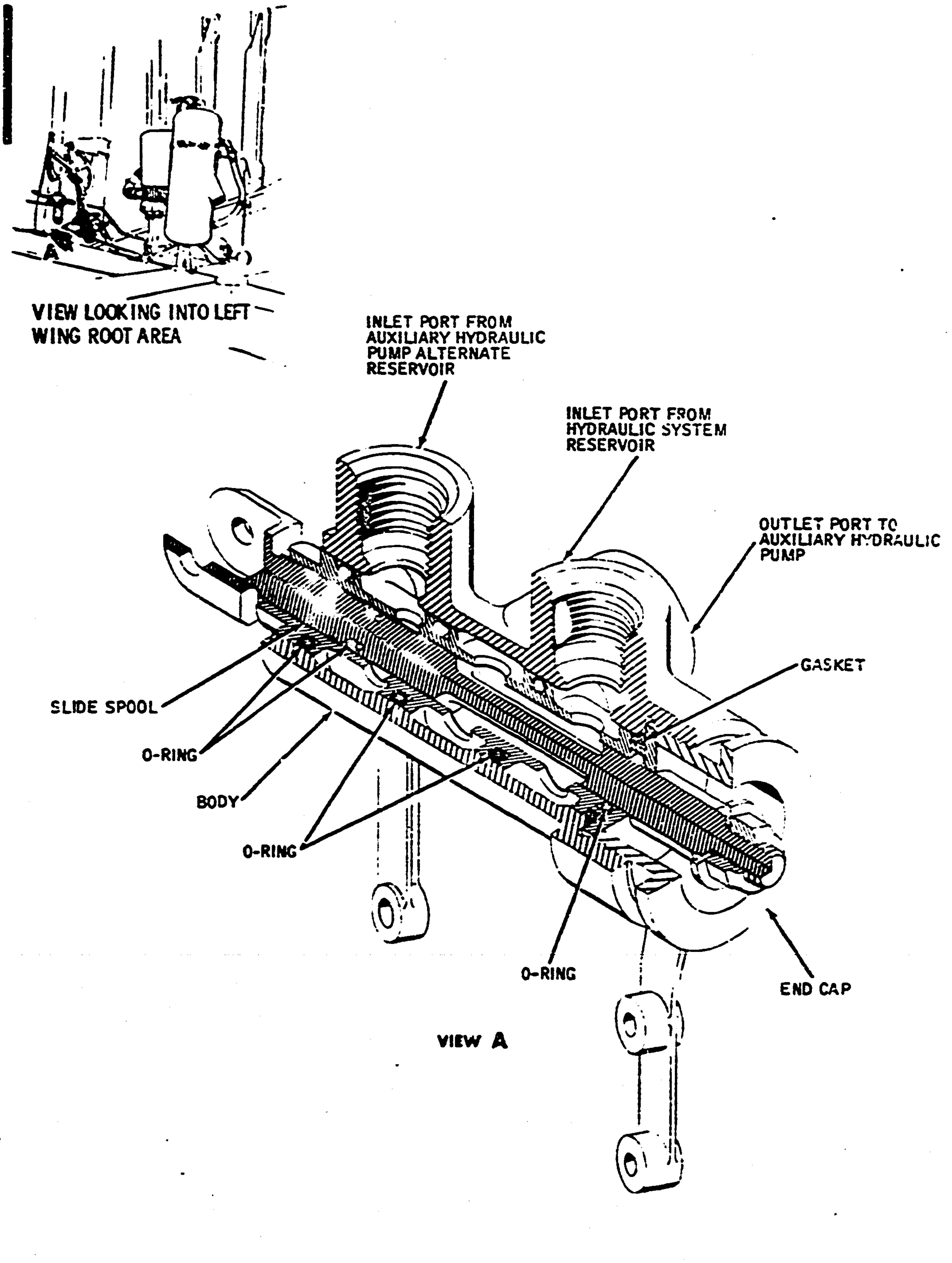
(1) The auxiliary hydraulic pump supply valve is a 2-position valve that ports hydraulic fluid from the reservoir, through a common outlet, to the auxiliary pump. The selector valve is located on the shear web in the left wing root, near the auxiliary pump. The selector valve is accessible through the left wing root access door.

(2) The valve body has two inlet ports and one outlet port. The outlet port is centrally located on the aft side of the valve body. The two inlet ports are located on the outboard side of the valve body, 90 degrees from the outlet port. Two mounting flanges are located on the inboard side of the valve body. These flanges are an integral part of the valve body.

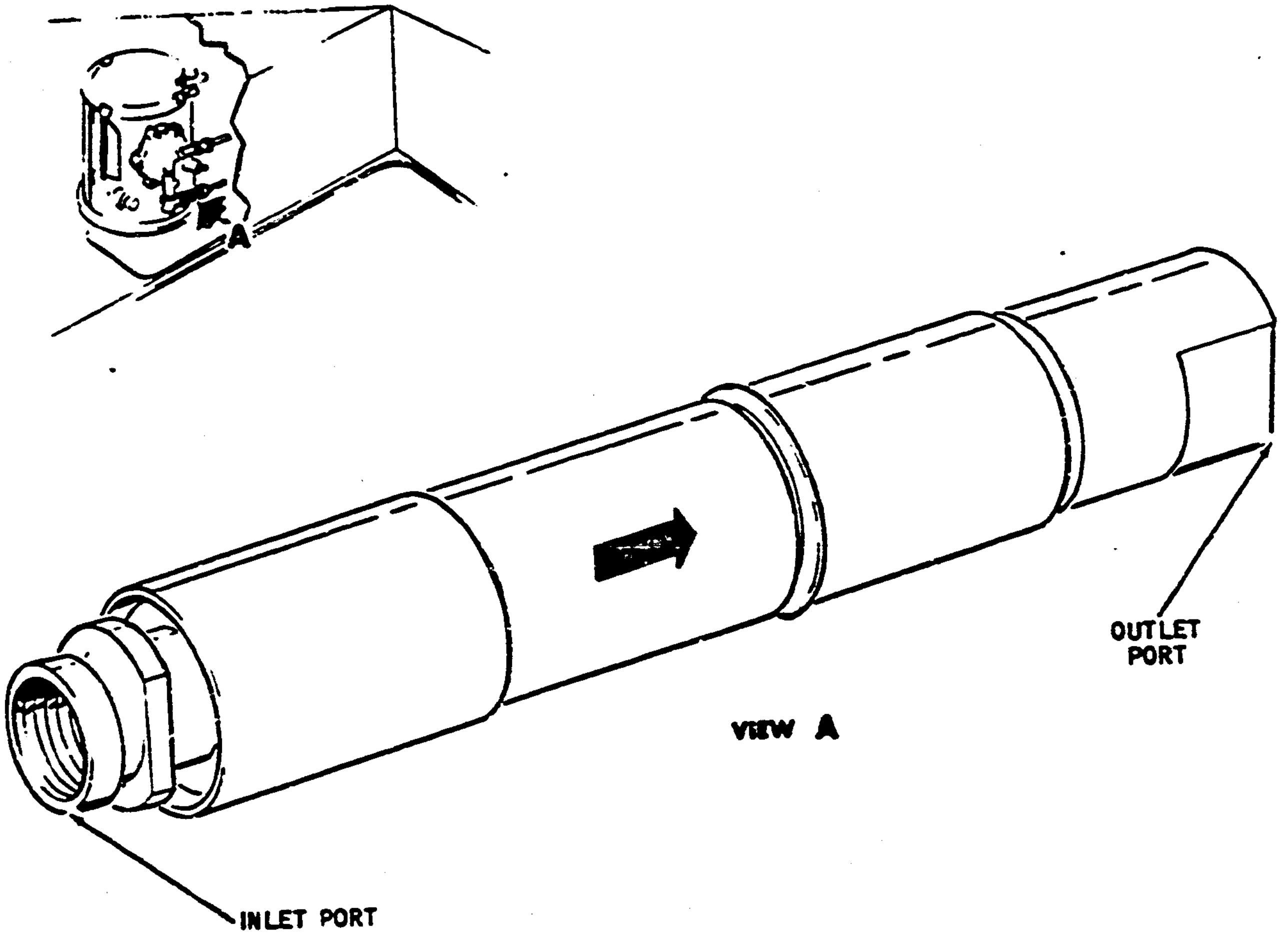
(3) During normal operation, fluid is taken from a low standpipe in the main hydraulic system reservoir and ported to the auxiliary pump. When the valve is in the alternate position, fluid is taken from the auxiliary hydraulic pump alternate reservoir and ported to the auxiliary pump. The valve is moved from the auxiliary position to the alternate position by placing the hydraulic system selector control lever, located on the system engineer's control pedestal, to the general system/flaps only position.

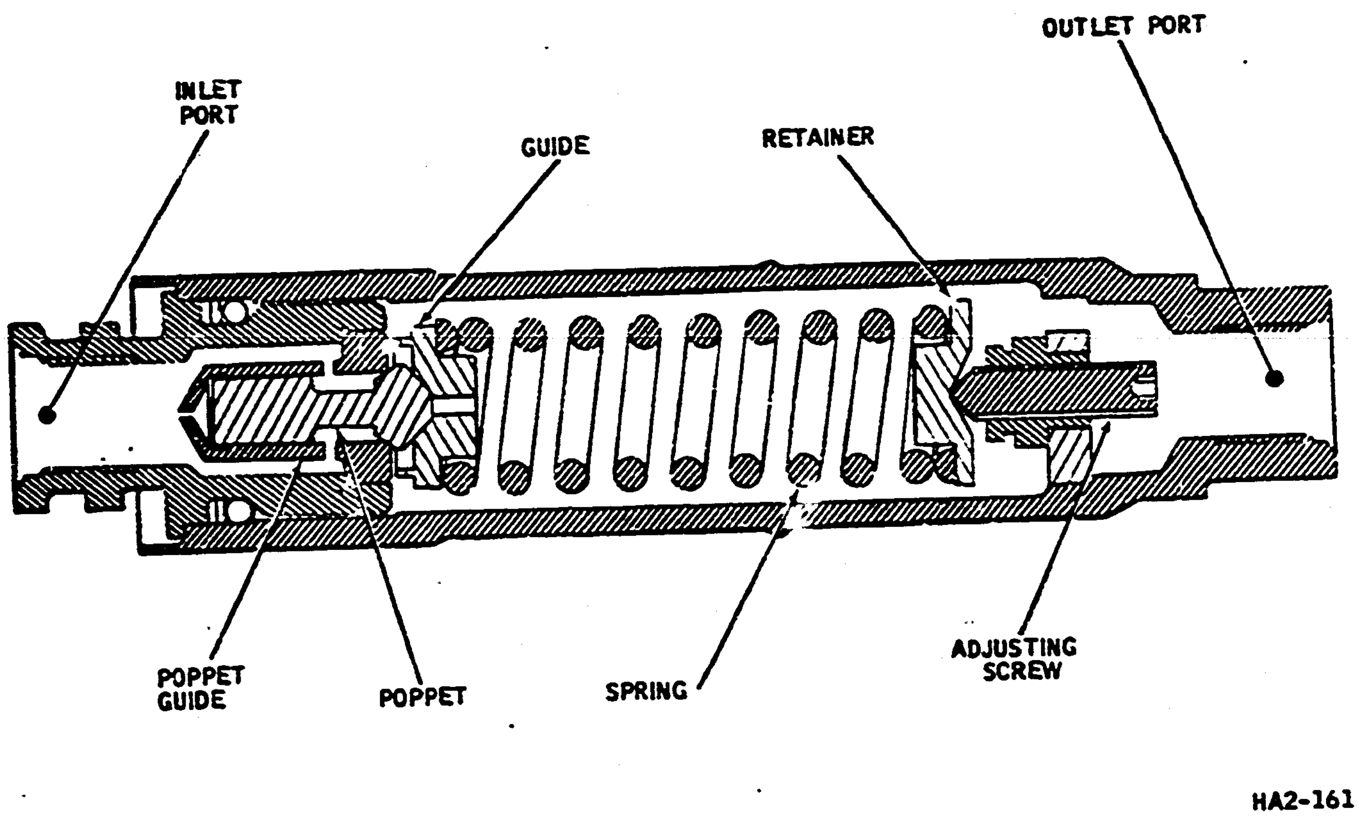
D. Auxiliary Hydraulic Pump Relief Valve (See Figure 3.)

(1) The auxiliary hydraulic pump relief valve is a spring loaded poppet-type valve and serves to relieve excess fluid pressure that may build up in the auxiliary hydraulic system. The relief valve connects, through a reducer, to a tee in the A return port of the hydraulic system reservoir. The valve is accessible through the left wing root access door.



Auxiliary Hydraulic Pump Supply Selector Valve -- Cutaway View
Figure 2





Auxiliary Hydraulic Pump Relief Valve -- Cutaway View
Figure 3

(2) Externally, the valve body is cylindrical, approximately 5 inches in length, and 1 inch in diameter. The outlet end of the valve is slightly larger than the inlet end.

(3) When pressure builds up, the poppet starts to relieve at approximately 3300 psi. If pressure continues to build up, the poppet continues to open until 3500 psi and a maximum flow of 3.5 gpm are reached. When pressure is relieved, the poppet reseats at 90 percent of the unseat pressure.

E. Auxiliary Hydraulic System Filter (See Figure 4.)

(1) A line-type, 10 micron filter assembly is installed in the piping of the auxiliary system to filter fluid from the pressure outlet port of the auxiliary pump to the system selector valve. On airplanes 801-811, the filter is located in the left wing root, just forward of the auxiliary hydraulic pump. On airplanes 812-822 and 860 and subsequent, the filter is located on the bulkhead near the forward inboard corner of the left main gear wheel well, slightly inboard and above the dual filter and relief valve. It is accessible through the left main gear inboard door.

(2) The inlet and outlet ports of the filter are internally threaded and are marked in and out. The filter bowl is cylindrical in shape, with wrench flats at the lower end, and is threaded into the assembly immediately below the ports. A hex-shaped magnetic plug is installed in the drain port. The filter element is stainless steel mesh, supported by a perforated cylindrical center core.

F. Auxiliary Hydraulic System Check Valve

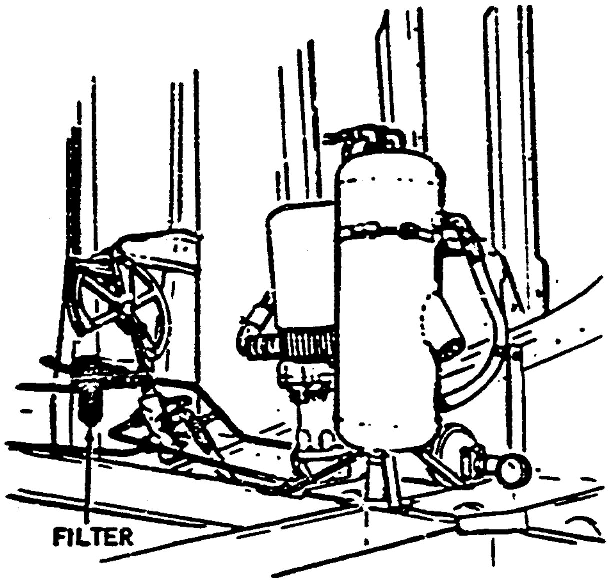
(1) The auxiliary hydraulic system check valve is a spring-loaded, poppet-type valve with a rated capacity of 3000 psi. This valve is installed in the line between the auxiliary hydraulic system filter and the system selector valve to prevent reverse flow of hydraulic fluid through the filter and the auxiliary pump when the engine-driven pumps or external pressure supply are used.

(2) The auxiliary hydraulic system check valve is located in the left wheel well, just above the dual filter and relief valve. The auxiliary hydraulic system check valve is accessible through the left wheel well.

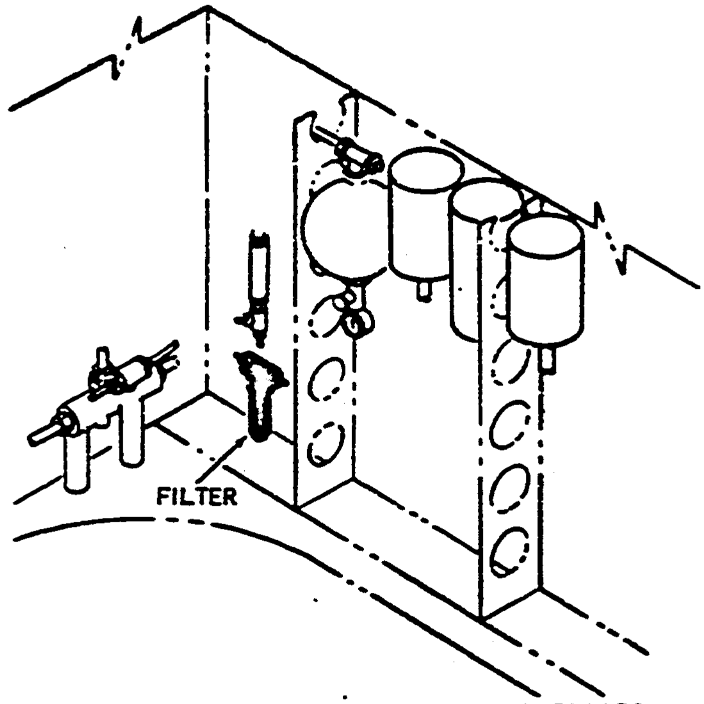
(3) Externally and internally, this valve is similar to the engine-driven hydraulic pump check valve, except for size.

G. Auxiliary Hydraulic System Surge Damper Accumulator (See Figure 5.)

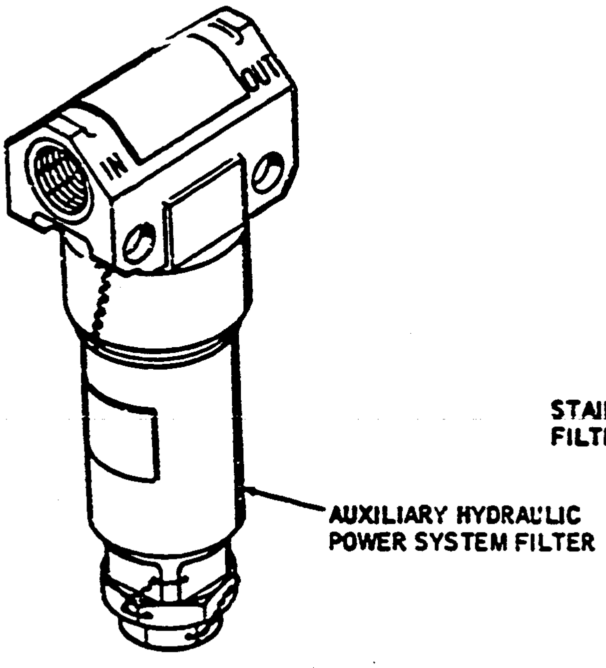
(1) The auxiliary hydraulic system surge damper accumulator consists of two spherical domes, separated by a diaphragm and held together by a ring nut. An air filler valve and gage are installed on the accumulator. The accumulator is installed in the auxiliary hydraulic pump pressure line just inboard and aft of the auxiliary pump, and is attached to the shear web by two clamp blocks. Access to the accumulator is through the left wing root access door.

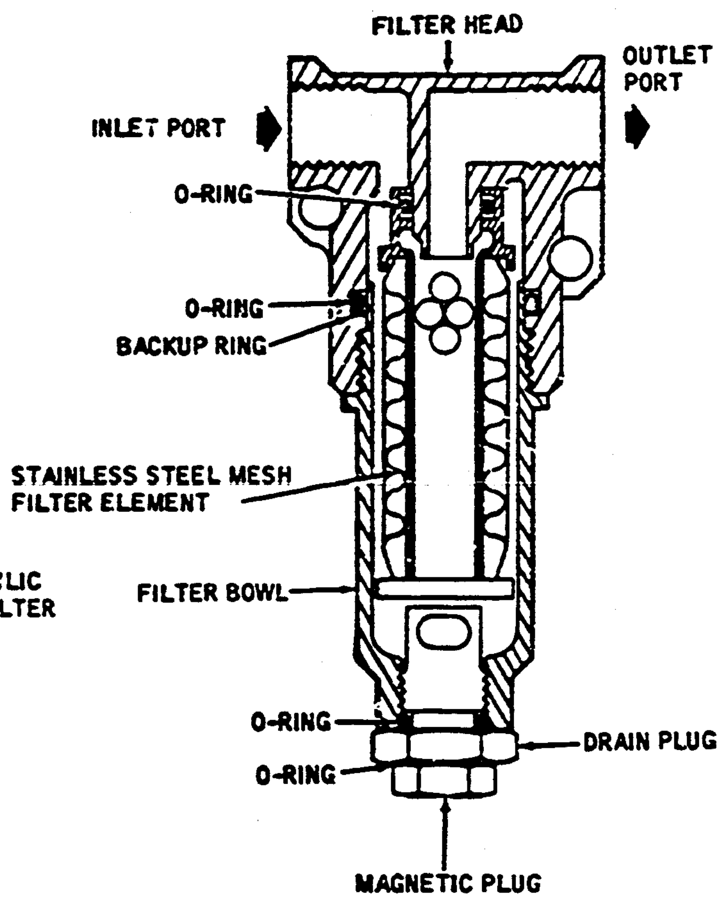


VIEW LOOKING FORWARD AND OUTBOARD
IN LEFT WING ROOT AREA
(AIRPLANES 801-811)



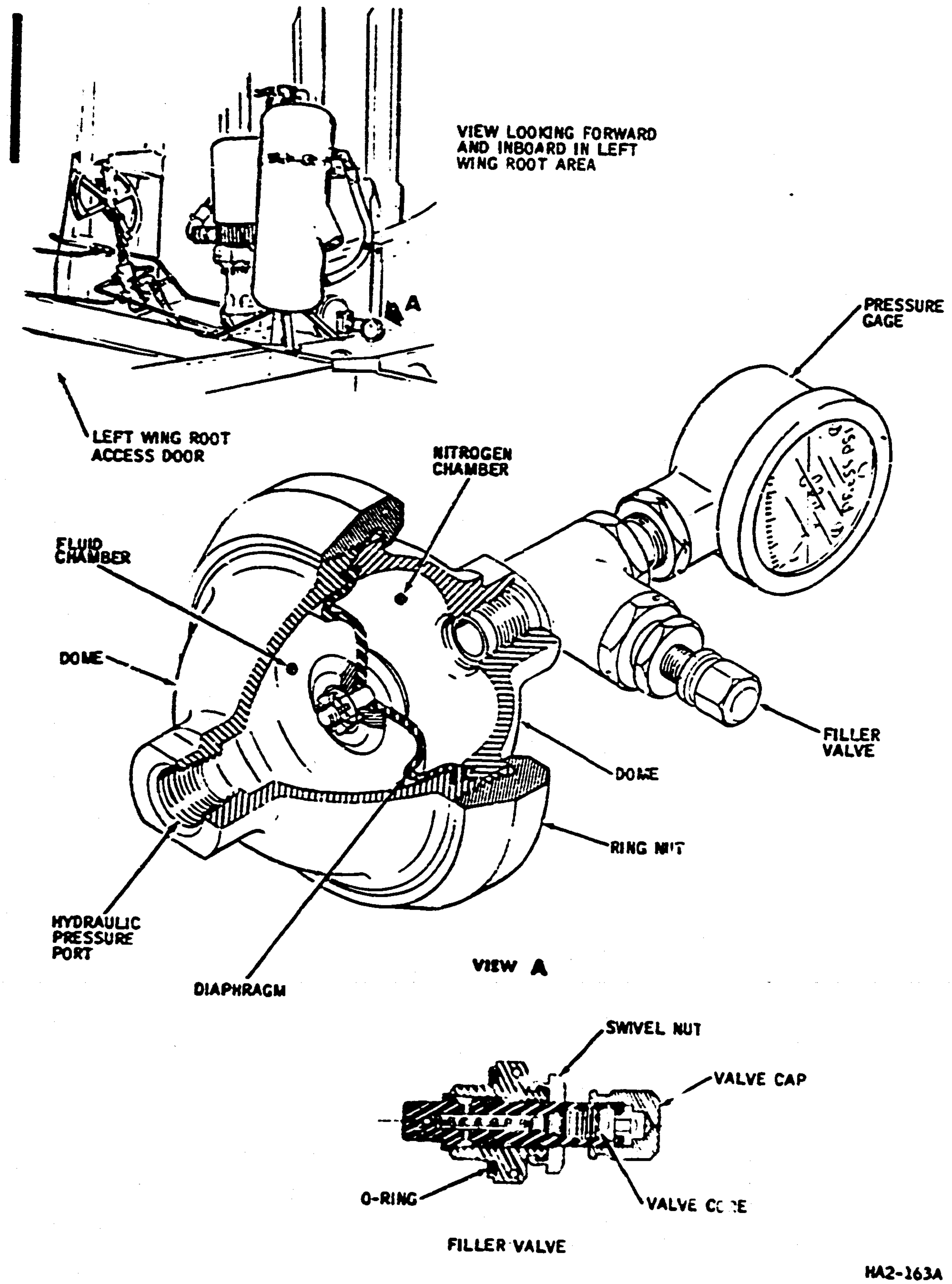
VIEW LOOKING FORWARD AND OUTBOARD
OF LEFT WHEEL WELL
(AIRPLANES 812-822 AND
860 AND SUBSEQUENT)





HA2-4662A

Auxiliary Hydraulic System Filter -- Cutaway View
Figure 4



Auxiliary Hydraulic Power System Surge
Damper Accumulator -- Cutaway View
Figure 5

(2) The accumulator is initially charged to 1000 psi with dry nitrogen. As the auxiliary system pressure builds up, fluid is forced against the diaphragm in the accumulator, further compressing the trapped nitrogen in the air side of the accumulator to full system pressure (2600 to 3000 psi is indicated on the accumulator pressure gage). The air in the accumulator absorbs the initial shock of the auxiliary pump output and permits the system pressure to rise gradually. The accumulator also serves to cushion the piping and system components against high impact loads.

H. Auxiliary Hydraulic Pump Control

(1) The auxiliary hydraulic pump control system consists of auxiliary hydraulic pump control switch, an auxiliary hydraulic pump control relay, an auxiliary hydraulic pump power relay, an electric motor, and an auxiliary pump on indicating light.

(2) The auxiliary hydraulic pump control switch(es), located in the flight compartment, are 3-position switches. They are spring-loaded to the center position and have two momentary positions placarded start (hold only in emergency) and stop.

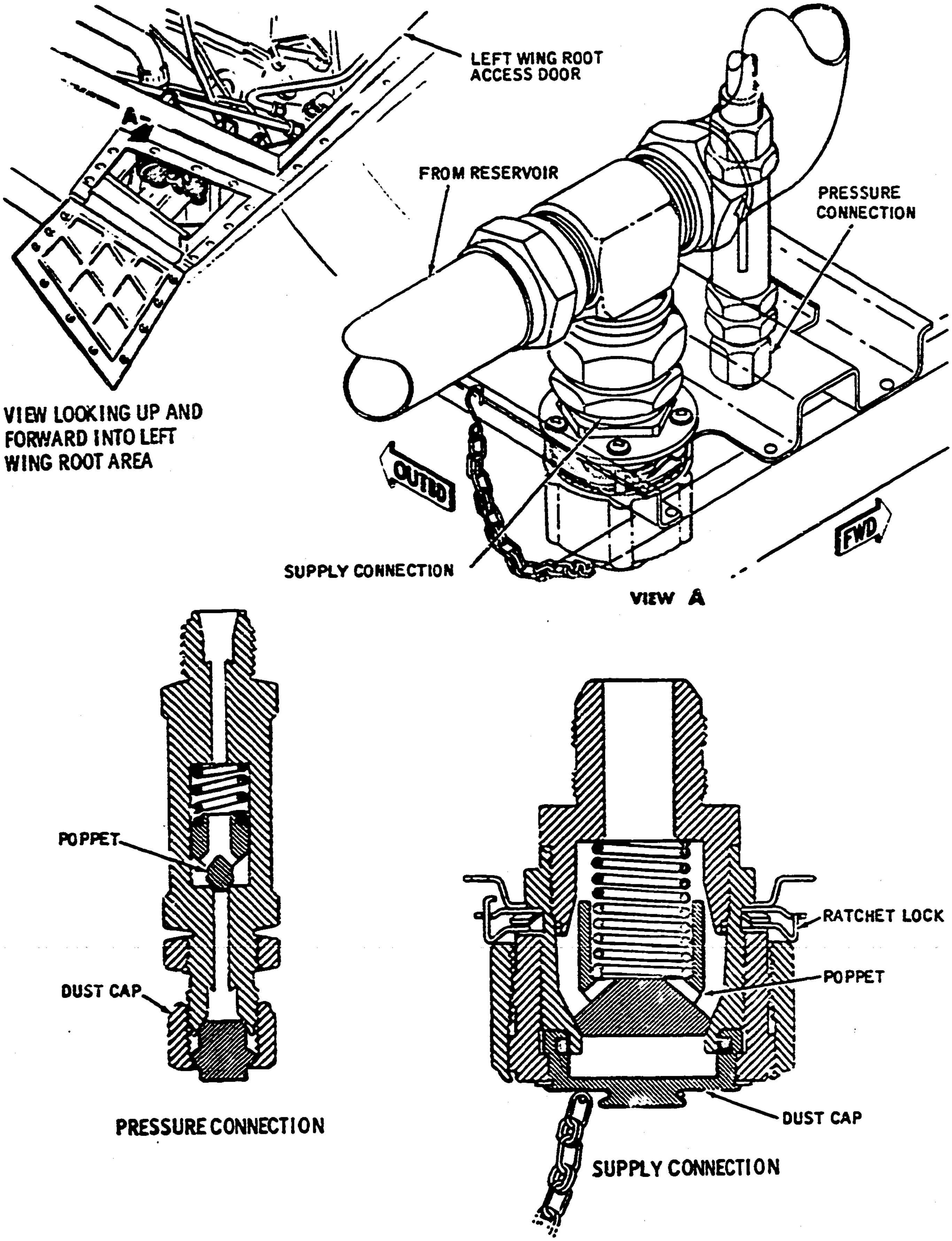
(3) On airplanes 812-819, a cargo door control handle manually actuated switch and circuitry are included in the auxiliary hydraulic pump circuit to energize the pump and provide hydraulic power for operation of the cargo door. For operation of cargo door systems and related precautions, see Chapter 52.

(4) The electric motor for the auxiliary hydraulic pump is an ac, 3-phase motor. A thermostatic switch is included in the circuit to protect the motor from overheating.

(5) The auxiliary hydraulic pump motor is supplied with power from the cabin bus 4. This permits pump operation from an external power source or from the airplane electrical system.

(6) The auxiliary pump on indicating light is a blue press-to-test light, located adjacent to the auxiliary hydraulic pump control switch. The light is equipped with a dimming feature.

(7) When the auxiliary hydraulic pump control switch is momentarily moved to the start position, the circuitry is completed between the auxiliary hydraulic pump control relay and cabin bus 4. The ground is through the stop contact of the switch and the thermostatic switch of the motor. Once the relay is energized, it remains energized through its own holding contacts. Through a closed contact of the pump control relay, power is supplied from cabin bus 4 to energize the hydraulic pump power relay. Through the closed contacts of the pump power relay, a power circuit is completed from the feeder leads of cabin bus 4 to



Ground Power Connectors -- Cutaway View
Figure 6

the auxiliary hydraulic pump motor. The blue indicating light, located in the flight compartment, receives power through one of the closed contacts of the pump power relay. Therefore, the light is on whenever the pump power relay is energized.

(8) The auxiliary hydraulic pump motor is safeguarded against overheating by the thermostatic switch. Under normal conditions, this switch is in the ground leg of the control relay. When an overheat condition occurs, the thermostatic switch opens the control relay circuit to limit the motor case to 450°F (252°C). This action deenergizes the control relay, which in turn deenergizes the power relay. In an emergency situation, the thermostatic switch can be overridden by holding the auxiliary hydraulic pump control switch in the start (hold only in emergency) position.

(9) When the auxiliary hydraulic pump control switch is placed in the momentary stop position, the ground for the control relay is broken, deenergizing the power relay and removing power from the pump motor and the indicating light.

I. Ground Service Pressure and Supply Connectors (See Figure 6.)

(1) The ground service pressure and supply connectors are external fittings to which a service unit can be connected for operating the hydraulic power system when there is no power on the airplane. The connectors are located on a panel covered by an access door on the lower skin of the left wing root, aft of the rear spar.

(2) The ground service pressure connector is made up of a check valve with a flared, bulkhead-type fitting on the inlet end and a standard tube fitting on the outlet end which connects to the left engine-driven pump pressure line. The inlet fitting is covered with a dust cap when not in use.

(3) The internal description of the connector is the same as that of the engine-driven hydraulic pump check valve (see 29-10-0, Description and Operation). The connector operates as a shutoff valve when the ground unit is not connected. When a ground hydraulic power source is connected to the pressure connector and pressure is applied, the poppet unseats and supplies pressure fluid to the hydraulic power system.

(4) The supply connector is made up of a T-fitting and a selfsealing coupling half. The tee is female-threaded to accept the bulkhead-type fitting on the upper end of the coupling. The cross arms of the tee tie into the right engine-driven pump supply line with flared-type fittings. The tee is threaded onto the coupling half and is secured with a locknut. The coupling consists of a coupling body, male-threaded to accept the coupling half from the ground source. The mounting flange has a recess to accept the hex portion of the coupling body, and has notches to retain the lockspring. A dust cap consisting of a union nut assembly, a dust plug, and a securing chain is installed on the lower end of the coupling when not in use.

AUXILIARY - DESCRIPTION AND OPERATION

1. General

A. The auxiliary hydraulic system is a supplementary hydraulic power system connected to the main hydraulic power system through the system selector valve. The auxiliary hydraulic system consists of an electrically driven auxiliary hydraulic pump, an auxiliary pump relief valve, a surge damper accumulator, an auxiliary filter and check valve, and the piping required to interconnect the components and connect the auxiliary system to the main power system.

B. In flight, the auxiliary hydraulic system can be used as supplemental power for the main power system. The auxiliary pump will also serve, when ground support equipment is not available, to pressurize the hydraulic power system for ground testing of the airplane hydraulic subsystems and components. Fluid is supplied to the auxiliary pump from a low standpipe in the hydraulic system reservoir. When the auxiliary pump is operated, fluid from the pressure outlet port of the auxiliary pump is ported, through the auxiliary power system filter and an auxiliary system check valve, to the auxiliary pressure inlet port of the system selector valve. When the system selector valve is in the normal position, auxiliary pump pressure is ported to the general system.

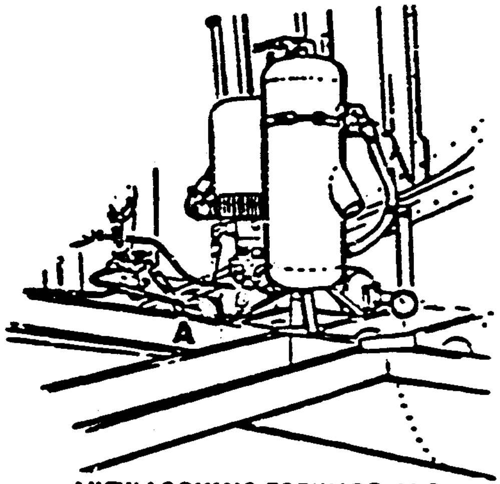
C. When the auxiliary pump is not operating, the auxiliary system check valve prevents reverse flow through the auxiliary pump from the engine-driven pumps. An auxiliary pump relief valve is teed into the line from the auxiliary pump outlet port to the reservoir filter inlet port. The valve relieves and ports excess fluid pressure back to the reservoir if auxiliary pressure builds above 3300 psi.

D. The auxiliary pump alternate reservoir is installed in the auxiliary hydraulic system to provide an alternate hydraulic fluid source in case of depletion of the normal supply to the hydraulic system reservoir. The alternate reservoir source is selectable by operation of the auxiliary hydraulic pump supply selector valve which actuates simultaneously with the hydraulic system selector valve.

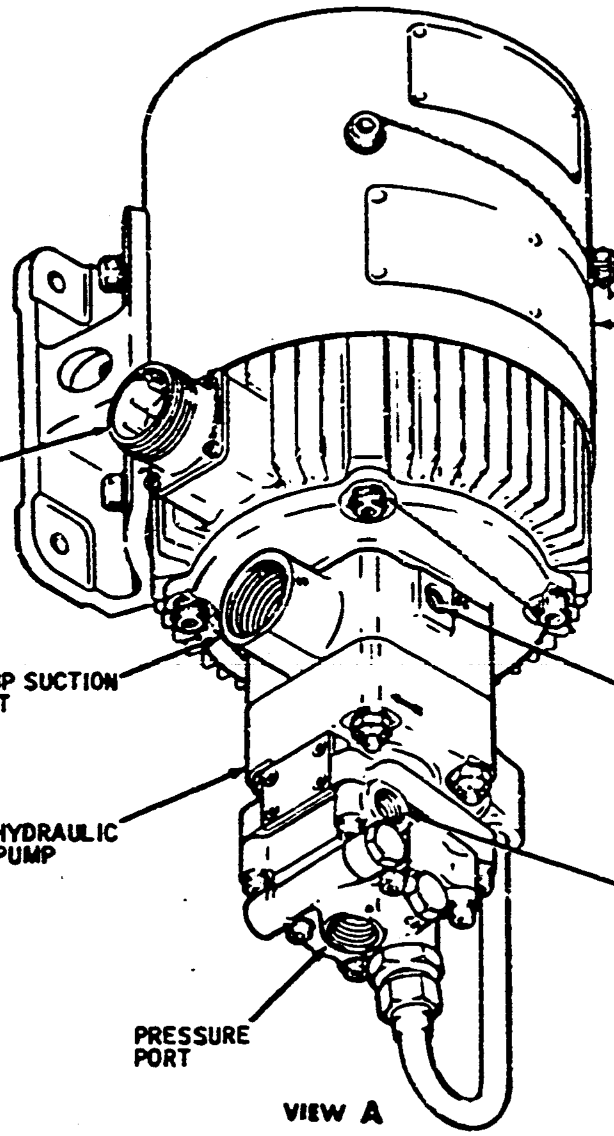
2. System Components

A. Auxiliary Hydraulic Pump (See Figure 1.)

(1) The auxiliary hydraulic pump, located in the left wing root access area, supplies hydraulic pressure for the auxiliary hydraulic system. The pump consists of an air cooled electric motor directly coupled through a shaft and centrifugal impeller to a variable displacement hydraulic pump.



VIEW LOOKING FORWARD AND
INBOARD AT LEFT WING ROOT AREA



VIEW A

HA2-3547

Auxiliary Hydraulic Pump -- Cutaway View
Figure 1

(2) The electric motor is a 115/200-volt, 3-phase, 400-cps, continuous duty motor rated at 6.5 hp at 11,300 rpm. The motor rotor has an internally splined output shaft which fits on the externally splined input shaft of the pump. The other end of the rotor shaft drives a cooling fan which forces cooling air between the motor case and the outer shroud. A thermoswitch located in the motor case is provided to shut off the motor in case of an overheat condition. An override function of the control switch in the flight compartment is provided to override the thermoswitch for emergency operation.

(3) The centrifugal impeller is located on the drive shaft between the motor and the variable displacement pump. The impeller draws hydraulic fluid from the system and supplies it through an external tube to the inlet port of the variable displacement pump under pressure, thereby helping to prevent cavitation of the pump.

(4) The variable displacement hydraulic pump consists of the following major parts: a four piece housing, drive shaft with impeller, axial cylinder barrel containing 9 pistons, pivoting hanger with an inclined camface, hold down plate, pressure compensating valve, and bearings.

(5) When the electric motor is actuated, the drive shaft rotates the centrifugal impeller and the cylinder and piston group. Each revolution of the cylinder causes one complete stroke of each piston. The pistons are held against the camface of the hanger by the hold down plate, providing positive piston return. The displacement of fluid from the pump discharge port is controlled by the compensator valve. The pump provides full flow of 3.9 gpm at system pressures up to approximately 2700 psi. At this point, the componsator valve reduces flow until at approximately 3000 psi, displacement of fluid is reduced to zero.

B. Auxiliary Hydraulic Pump Alternate Reservoir

(1) The auxiliary hydraulic pump alternate reservoir is installed on the shear web in the left wing root area, immediately aft of the auxiliary hydraulic pump. Access to the reservoir is through the left wing root access door. The alternate reservoir supplies hydraulic fluid to the auxiliary hydraulic pump in the event the fluid supply from the main hydraulic system reservoir is exhausted.

(2) The reservoir is cylindrical in shape and has a fluid capacity of approximately 1.9 US gallons (1.6 Imperial gallons or 7.3 liters). There are four ports on the reservoir: an outlet port to the auxiliary hydraulic pump selector valve located at the bottom, an inlet port from the auxiliary hydraulic pump case drain located near the top on the side, an inlet from the wing flap return line, and an outlet to the main hydraulic reservoir located at the top. A sight gage is installed near the top of the reservoir for visual indication of fluid level, and a mounting boss for the emergency hydraulic level indicating light switch is installed on the side of the reservoir.

(3) The reservoir is kept full during operation by routing fluid from the wing flap return line to the reservoir. Fluid in excess of the alternate reservoir capacity is then routed to the main hydraulic system reservoir. Hydraulic fluid from the auxiliary pump case drain is routed to the alternate reservoir and then to the main reservoir. Fluid is used from the alternate reservoir only when the auxiliary pump is operating and the auxiliary pump supply selector valve is in the alternate position. Fluid supply to the alternate reservoir is replenished whenever the wing flaps are operated.

C. Auxiliary Hydraulic Pump Supply Selector Valve (See Figure 2.)

(1) The auxiliary hydraulic pump supply valve is a 2-position valve that ports hydraulic fluid from either reservoir, through a common outlet, to the auxiliary pump. The selector valve is located on the shear web in the left wing root, near the auxiliary pump. The selector valve is accessible through the left wing root access door.

(2) The valve body has two inlet ports and one outlet port. The outlet port is centrally located on the aft side of the valve body. The two inlet ports are located on the outboard side of the valve body, 90 degrees from the outlet port. Two mounting flanges are located on the inboard side of the valve body. These flanges are an integral part of the valve body.

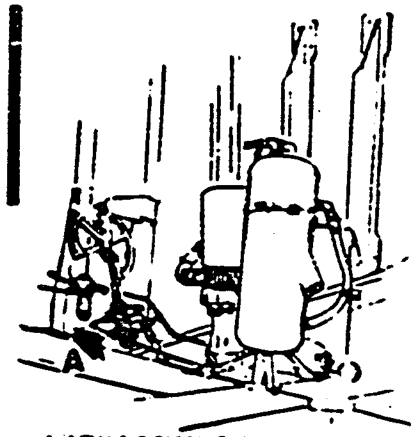
(3) During normal operation, fluid is taken from a low standpipe in the main hydraulic system reservoir and ported to the auxiliary pump. When the valve is in the alternate position, fluid is taken from the auxiliary hydraulic pump alternate reservoir and ported to the auxiliary pump. The valve is moved from the auxiliary position to the alternate position by placing the hydraulic system selector control lever, located on the system engineer's control pedestal, to the general system/flaps only position.

D. Auxiliary Hydraulic Pump Relief Valve (See Figure 3.)

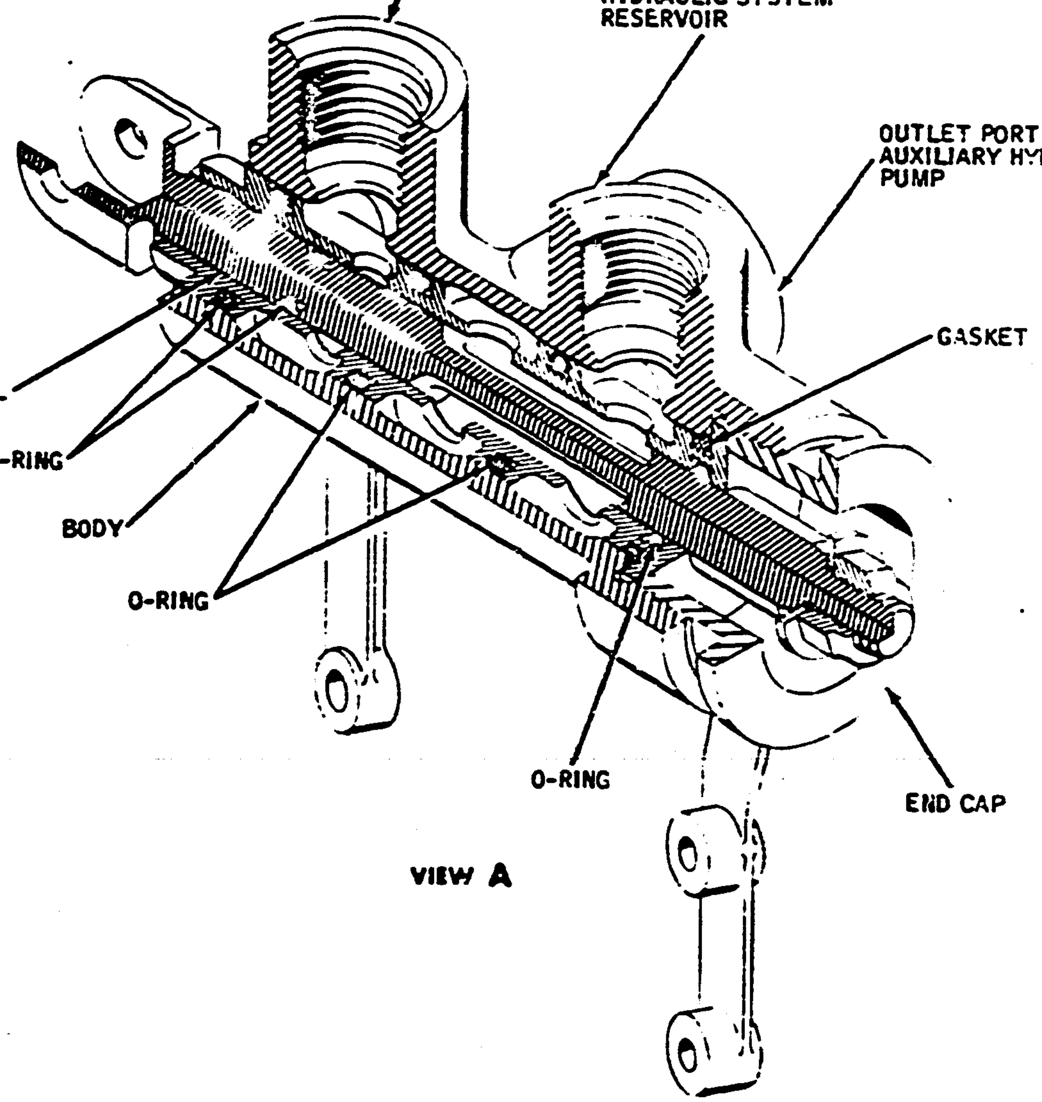
(1) The auxiliary hydraulic pump relief valve is a spring loaded poppet-type valve and serves to relieve excess fluid pressure that may build up in the auxiliary hydraulic system The relief valve connects, through a reducer, to a tee in the A return port of the hydraulic system reservoir. The valve is accessible through the left wing root access door.

(2) Externally, the valve body is cylindrical, approximately 5 inches in length, and 1 inch in diameter. The outlet end of the valve is slightly larger than the inlet end.

(3) When pressure builds up, the poppet starts to relieve at approximately 3300 psi. If pressure continues to build up, the poppet continues to open until 3500 psi and a maximum flow of 3.5 gpm are reached. When pressure is relieved, the poppet reseats at 90 percent of the unseat pressure.



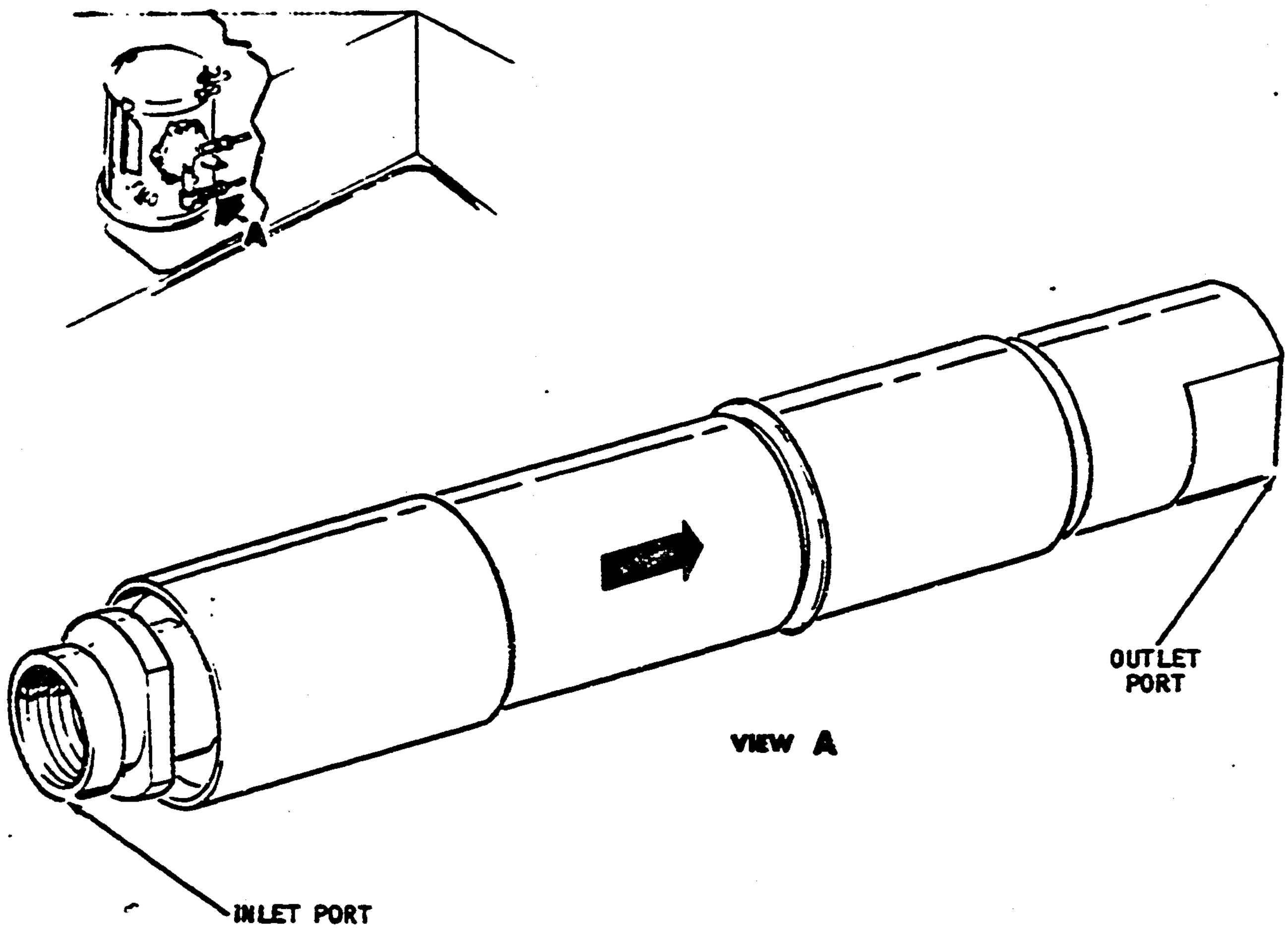
VIEW LOOKING INTO LEFT WING ROOT AREA

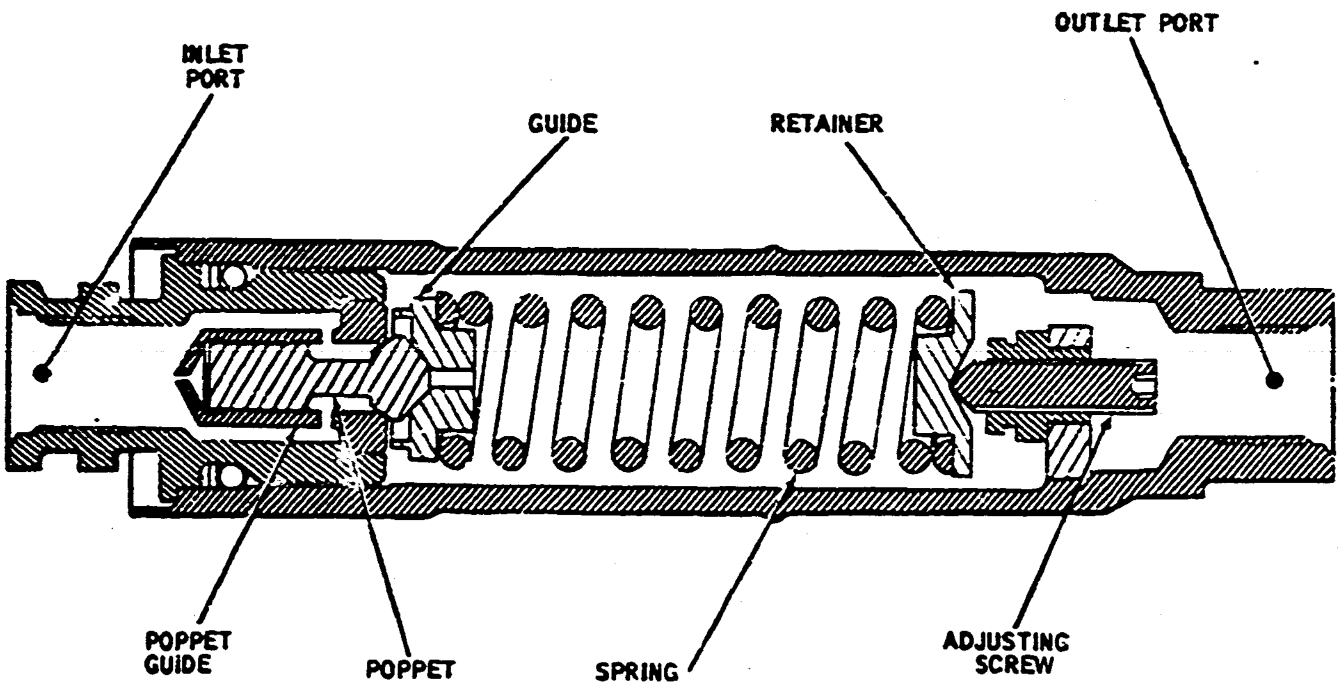


VIEW A

HA2-160A

Auxiliary Hydraulic Pump Supply Selector Valve -- Cutaway View
Figure 2





HA2-161

Auxiliary Hydraulic Pump Relief Valve -- Cutaway View
Figure 3

E. Auxiliary Hydraulic System Filter (See Figure 4.)

(1) A line-type, 10 micron filter assembly is installed in the piping of the auxiliary system to filter fluid from the pressure outlet port of the auxiliary pump to the system selector valve. The filter is located on the bulkhead near the forward inboard corner of the left main gear wheel well, slightly inboard and above the dual filter and relief valve. It is accessible through the left main gear inboard door.

(2) The inlet and outlet ports of the filter are internally threaded and are marked in and out. The filter bowl is cylindrical in shape, with wrench flats at the lower end, and is threaded into the assembly immediately below the ports. A hex-shaped magnetic plug is installed in the drain port. The filter element is stainless steel mesh, supported by a perforated cylindrical center core.

F. Auxiliary Hydraulic System Check Valve

(1) The auxiliary hydraulic system check valve is a spring-loaded, poppet-type valve with a rated capacity of 3000 psi. This valve is installed in the line between the auxiliary hydraulic system filter and the system selector valve to prevent reverse flow of hydraulic fluid through the filter and the auxiliary pump when the engine-driven pumps or external pressure supply are used.

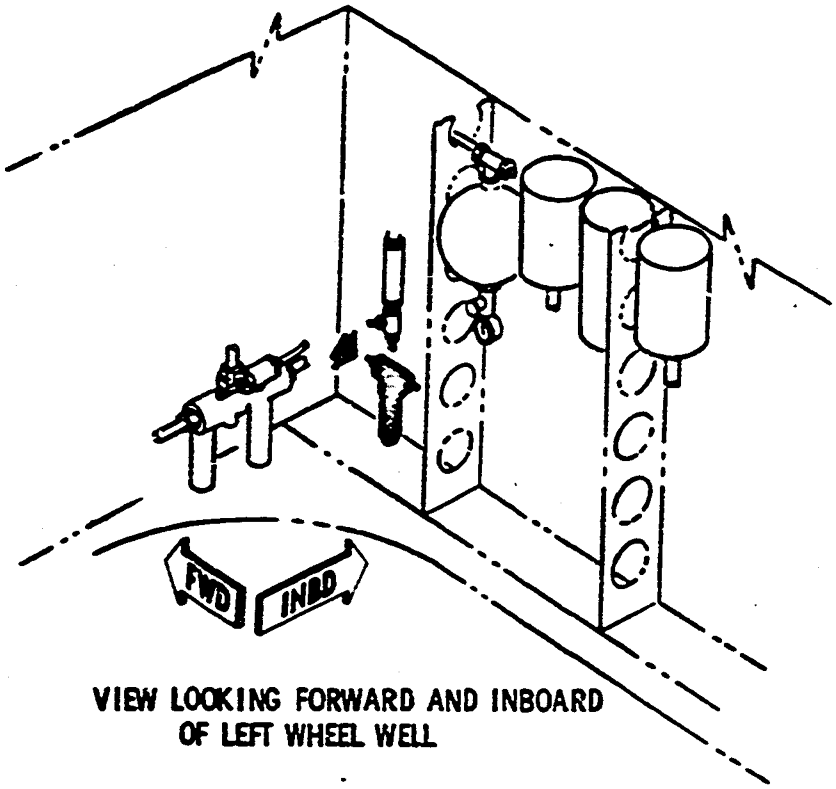
(2) The auxiliary hydraulic system check valve is located in the left wheel well, just above the dual filter and relief valve. The auxiliary hydraulic system check valve is accessible through the left wheel well.

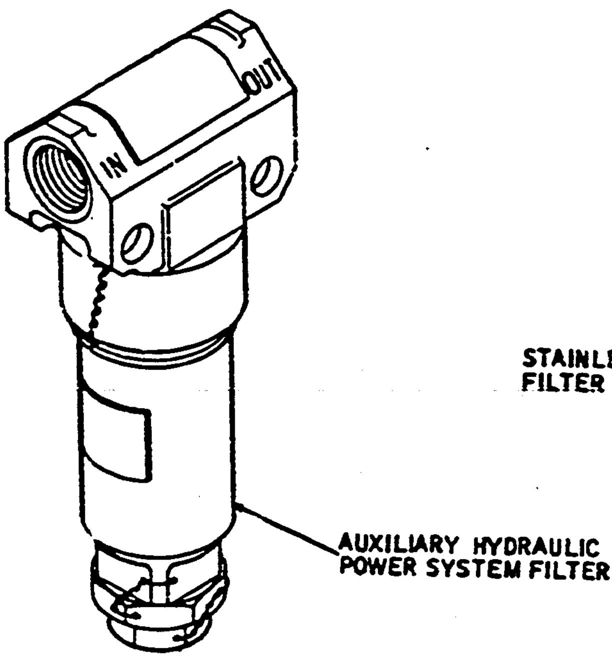
(3) Externally and internally, this valve is similar to the engine-driven hydraulic pump check valve, except for size.

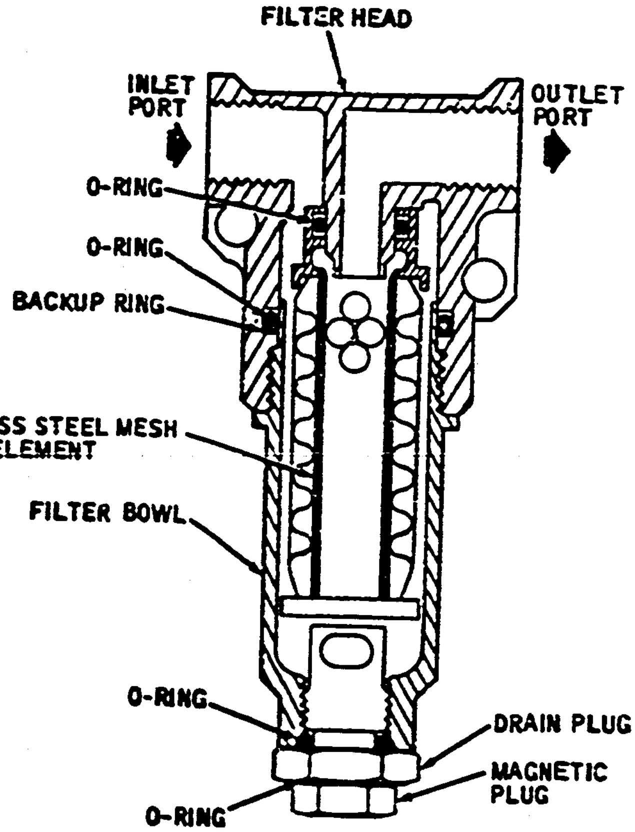
G. Auxiliary Hydraulic System Surge Damper Accumulator (See Figure 5.)

(1) The auxiliary hydraulic system surge damper accumulator consists of two spherical domes, separated by a diaphragm and held together by a ring nut. An air filler valve and gage are installed on the accumulator. The accumulator is installed in the auxiliary hydraulic pump pressure line just inboard and aft of the auxiliary pump, and is attached to the shear web by two clamp blocks. Access to the accumulator is through the left wing root access door.

(2) The accumulator is initially charged to 1000 psi with dry nitrogen. As the auxiliary system pressure builds up, fluid is forced against the diaphragm in the accumulator, further compressing the trapped nitrogen in the air side of the accumulator to full system pressure (2600 to 3000 psi is indicated on the accumulator pressure gage). The air in the accumulator absorbs the initial shock of the auxiliary pump output and permits the system pressure to rise gradually. The accumulator also serves to cushion the piping and system components against high impact loads.

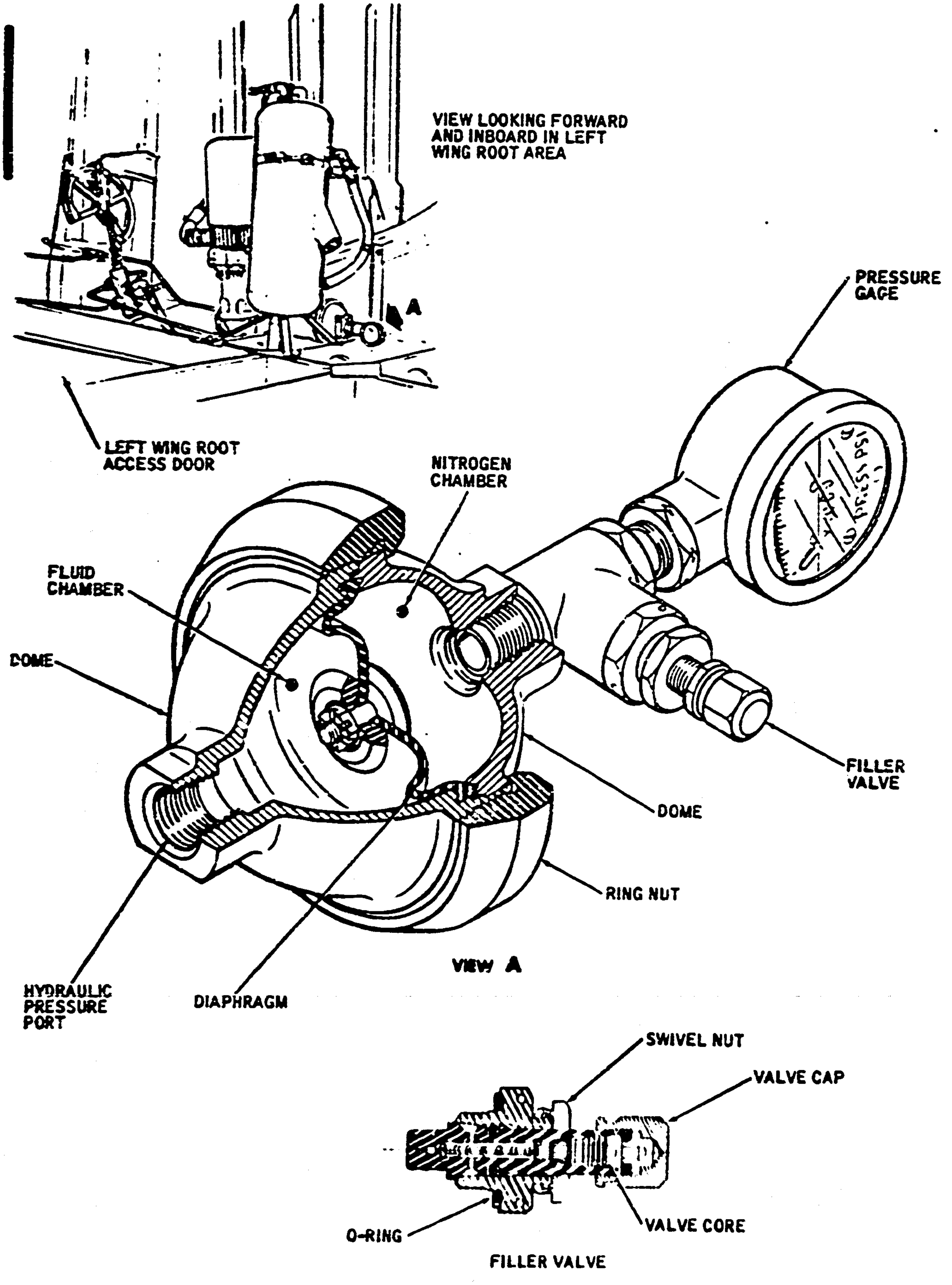






HA2-162

Auxiliary Hydraulic System Filter -- Cutaway View
Figure 4



Auxiliary Hydraulic Power System Surge Damper
Accumulator -- Cutaway View
Figure 5

H. Auxiliary Hydraulic Pump Control

(1) The auxiliary hydraulic pump control system consists of auxiliary hydraulic pump control switch, an auxiliary hydraulic pump control relay, an auxiliary hydraulic pump power relay, an electric motor, and an auxiliary pump on indicating light.

(2) The auxiliary hydraulic pump control switch(es), located in the flight compartment, are 3-position switches. They are spring-loaded to the center position and have two momentary positions placarded start (hold only in emergency) and stop.

(3) The electric motor for the auxiliary hydraulic pump is an ac, 3-phase motor. A thermostatic switch is included in the circuit to protect the motor from overheating.

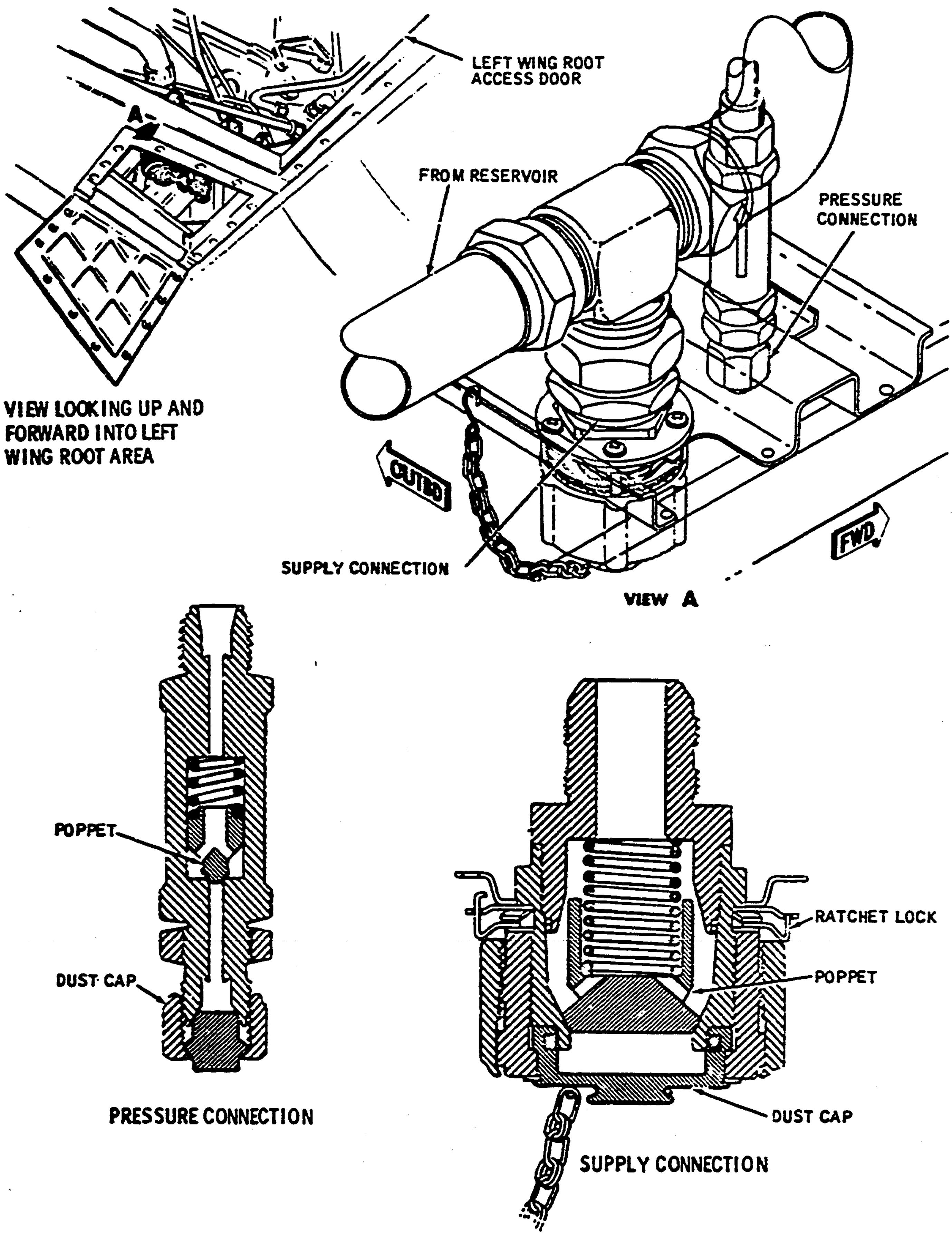
(4) The auxiliary hydraulic pump motor is supplied with power from the cabin bus 4. This permits pump operation from an external power source or from the airplane electrical system.

(5) The auxiliary pump on indicating light is a blue press-to-test light, located adjacent to the auxiliary hydraulic pump control switch. The light is equipped with a dimming feature.

(6) When the auxiliary hydraulic pump control switch is momentarily moved to the start position, the circuitry is completed between the auxiliary hydraulic pump control relay and cabin bus 4. The ground is through the stop contact of the switch and the thermostatic switch of the motor. Once the relay is energized, it remains energized through its own holding contacts. Through a closed contact of the pump control relay, power is supplied from cabin bus 4 to energize the hydraulic pump power relay. Through the closed contacts of the pump power relay, a power circuit is completed from the feeder leads of cabin bus 4 to the auxiliary hydraulic pump motor. The blue indicating light, located in the flight compartment, receives power through one of the closed contacts of the pump power relay. Therefore, the light is on whenever the pump power relay is energized.

(7) The auxiliary hydraulic pump motor is safeguarded against overheating by the thermostatic switch. Under normal conditions, this switch is in the ground leg of the control relay. When an overheat condition occurs, the thermostatic switch opens the control relay circuit to limit the motor case to 450°F (252°C). This action deenergizes the control relay, which in turn deenergizes the power relay. In an emergency situation, the thermostatic switch can be overriden by holding the auxiliary hydraulic pump control switch in the start (hold only in emergency) position.

(8) When the auxiliary hydraulic pump control switch is placed in the momentary stop position, the ground for the control relay is broken, deenergizing the power relay and removing power from the pump motor and the indicating light.



HA2-164

Ground Power Connectors -- Cutaway View
Figure 6

I. Ground Service Pressure and Supply Connectors (See Figure 6.)

(1) The ground service pressure and supply connectors are external fittings to which a service unit can be connected for operating the hydraulic power system when there is no power on the airplane. The connectors are located on a panel covered by an access door on the lower skin of the left wing root, aft of the rear spar.

(2) The ground service pressure connector is made up of a check valve with a flared, bulkhead-type fitting on the inlet end and a standard tube fitting on the outlet end which connects to the left engine-driven pump pressure line. The inlet fitting is covered with a dust cap when not in use.

(3) The internal description of the connector is the same as that of the engine-driven hydraulic pump check valve (see 29-10-0, Description and Operation). The connector operates as a shutoff valve when the ground unit is not connected. When a ground hydraulic power source is connected to the pressure connector and pressure is applied, the poppet unseats and supplies pressure fluid to the hydraulic power system.

(4) The supply connector is made up of a T-fitting and a self-sealing coupling half. The tee is female-threaded to accept the bulkhead-type fitting on the upper end of the coupling. The cross arms of the tee tie into the right engine-driven pump supply line with flared-type fittings. The tee is threaded onto the coupling half and is secured with a locknut. The coupling consists of a coupling body, male-threaded to accept the coupling half from the ground source. The mounting flange has a recess to accept the hex portion of the coupling body, and has notches to retain the lockspring. A dust cap consisting of a union nut assembly, a dust plug, and a securing chain is installed on the lower end of the coupling when not in use.

AUXILIARY - DESCRIPTION AND OPERATION

1. General

A. The auxiliary hydraulic system is a supplementary hydraulic power system connected to the main hydraulic power system through the system selector valve and the auxiliary pump supply selector valve. The auxiliary hydraulic system consists of an electrically driven auxiliary hydraulic pump, an auxiliary pump relief valve, a surge damper accumulator, and auxiliary filter and check valve, and the piping required to interconnect the components and connect the auxiliary system to the main power system.

B. In flight, the auxiliary hydraulic system can be used as supplemental power for the main power system. The auxiliary pump will also serve, when ground support equipment is not available, to pressurize the hydraulic power system for ground testing of the airplane hydraulic subsystems and components. Fluid is supplied to the auxiliary pump from a low standpipe in the hydraulic system reservoir. When the auxiliary pump is operated, fluid from the pressure outlet port of the auxiliary pump is ported, through the auxiliary power system filter and an auxiliary system check valve, to the auxiliary pressure inlet port of the system selector valve. When the system selector valve is in the normal position, auxiliary pump pressure is ported to the general system.

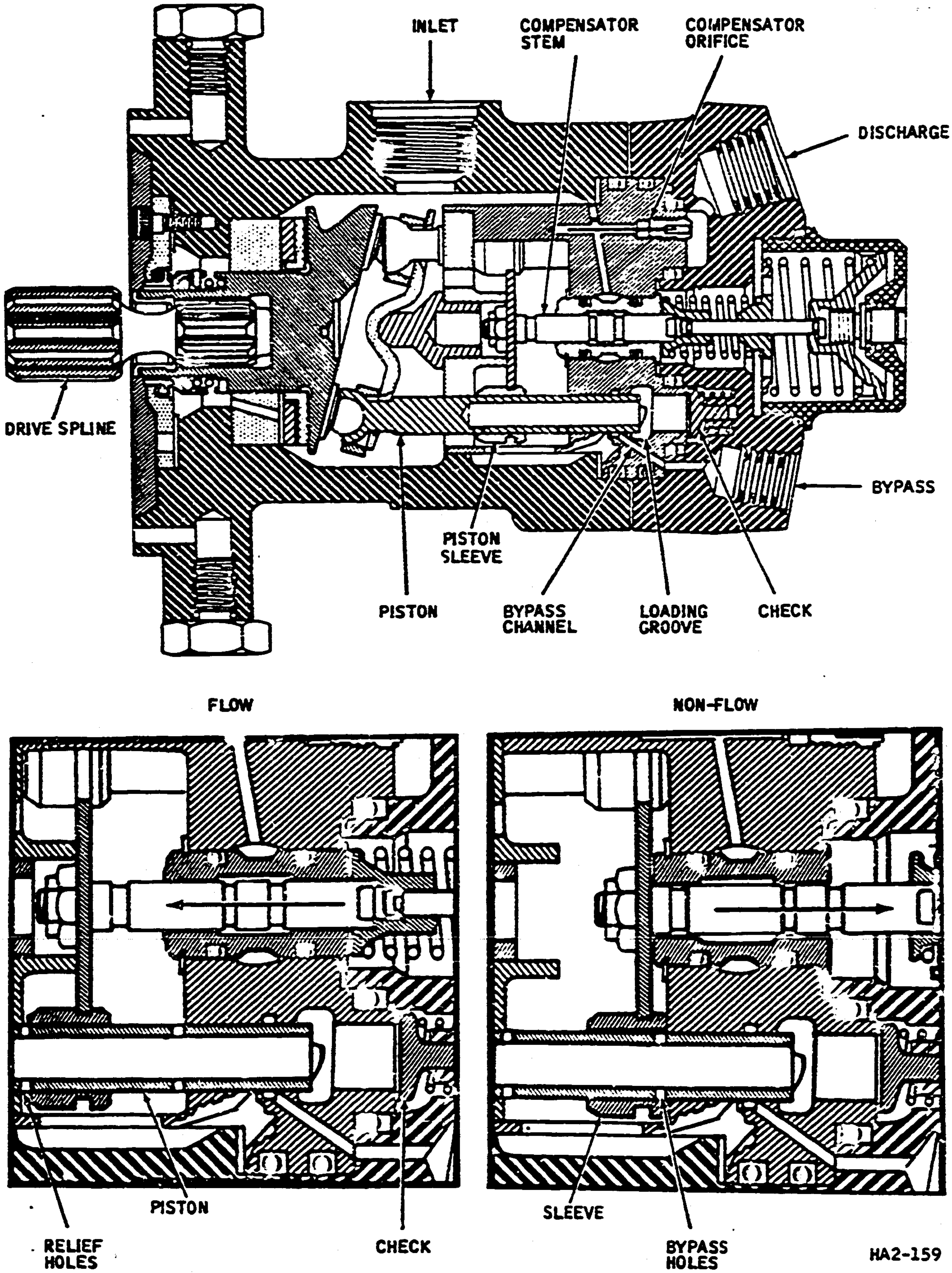
C. When the auxiliary pump is not operating, the auxiliary system check valve prevents reverse flow through the auxiliary pump from the engine-driven pumps. An auxiliary pump relief valve is teed into the line from the auxiliary pump outlet port to the reservoir filter inlet port. The valve relieves and ports excess fluid pressure back to the reservoir if auxiliary pressure builds above 3300 psi.

D. The auxiliary pump alternate reservoir is installed in the auxiliary hydraulic system to provide an alternate hydraulic fluid source in case of depletion of the normal supply to the hydraulic system reservoir. The alternate reservoir source is selectable by operation of the auxiliary hydraulic pump supply selector valve which actuates simultaneously with the hydraulic system selector valve.

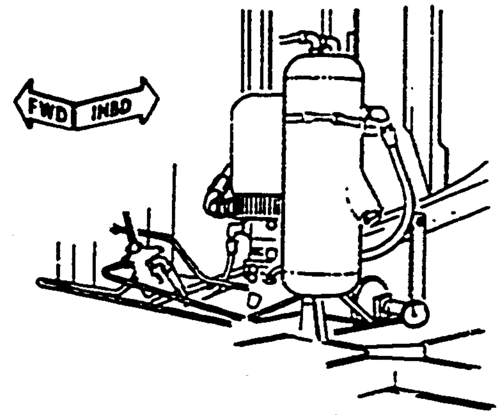
2. System Components

A. Auxiliary Hydraulic Pump (See Figure 1.)

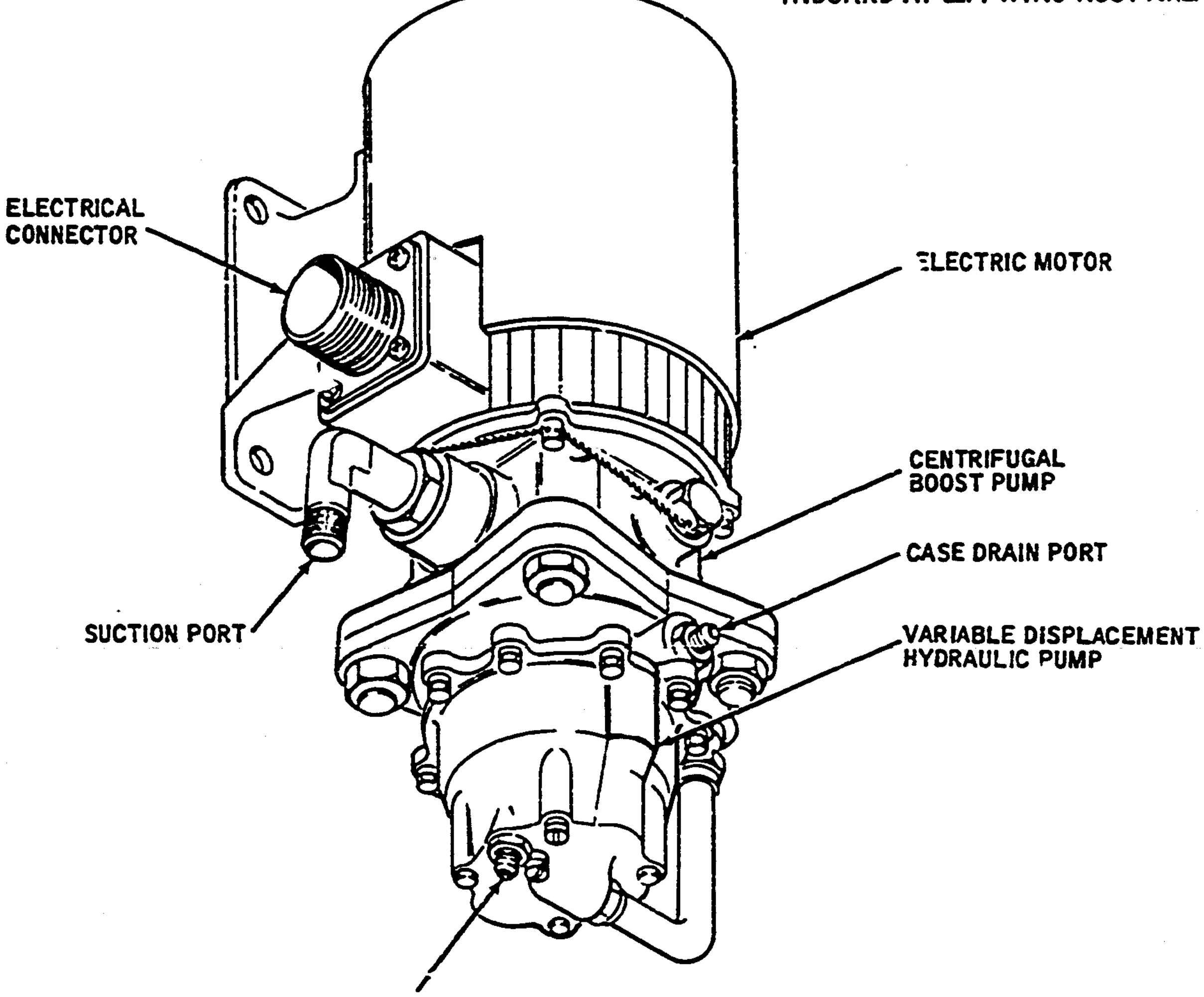
(1) The auxiliary hydraulic pump (Airplanes N8762-N8778) is an electrically driven, continuous-duty pressure-compensated, variable-displacement pump. An automatic pressure-sensing mechanism (compensator) within the pump regulates the amount of fluid delivered to the airplane hydraulic system. The quantity of delivery is dependent on the system pressure. Flow is reduced to zero when desired system pressure is achieved.



Auxiliary Hydraulic Pump -- Cutaway View
(Airplanes N8762-N8778)
Figure 1 (Sheet 1)



VIEW LOOKING FORWARD AND INBOARD AT LEFT WING ROOT AREA



HA2-5780

Auxiliary Hydraulic Pump
(Airplanes N8755-N8760)
Figure 1 (Sheet 2)

(2) The internal components of the pump perform three major functions; mechanical drive (motor), fluid displacement (pistons), and pressure control (compensator). Mechanical drive is supplied by a 200-vac, 3-phase, 400-cycle electric motor.

(3) As the hydraulic fluid from the reservoir enters the inlet port, the fluid is displaced by axial piston motion. As a piston advances in a cylinder bore, it forces a quantity of fluid past the pump check at the end of the bore. When the piston bypass holes become aligned hydraulically with cylinder block passage, pressurized fluid also escapes to bypass; then a combination of spring pressure and system back pressure closes the pump checks. In the withdrawal portion of the piston stroke, a partial vacuum is created in the cylinder bore, allowing new fluid from the intake to flow into the bore from the pressurized reservoir. The quantity of fluid delivered by each piston stroke is controlled by relief holes, in the pistons and piston sleeves.

(4) Unless the relief holes are covered by the piston sleeves, no fluid is forced past the pump checks. Quantity of delivery is therefore determined by the position of the piston sleeves, which in turn is determined by system pressure bled through the compensator orifices. Because one sleeve is slightly longer than the others, the pump, even when in full cutoff, continues to pump enough fluid to make up for any minor drop in the system pressure due to leakage.

(5) Pressure control: System pressure, acting through the compensator orifice on the compensator stem, controls the piston sleeve position and, therefore, determines whether the pump delivers at full capacity, partial capacity, or cuts off entirely. Path of fluid flow through the pump remains the same in all three conditions. When the pressure at the outlet port reaches 2700 psi, pressure in the compensator commences to reduce the output until 3000 psi is reached, at which time fluid flow is zero. The bypass system is provided to supply self-lubrication, particularly when the pump is in non-delivery (cutoff) operation. The ring of bypass holes in the pistons is hydraulically aligned with the bypass passage each time a piston reached the very end of its forward travel period. This pumps a small quantity of fluid out the bypass passage back to the supply reservoir and provides a constant changing of the fluid in the pump. The bypass is designed to pump against a considerable back pressure for use with pressurized hydraulic reservoirs.

(6) On airplanes N8755-N8760 the auxiliary hydraulic pump, located in the left wing root access area, supplies hydraulic pressure for the auxiliary hydraulic system. The pump consists of an air cooled electric motor directly coupled through a shaft and centrifugal boost pump impeller to a variable displacement hydraulic pump.

(7) The electric motor is a 115/200-volt, 3-phase, 400-cps, continuous duty motor. The motor rotor has an internally splined output shaft which fits on the externally splined input shaft of the pump. The other end of the rotor shaft drives a cooling fan which forces cooling air between the motor case and the outer shroud. A thermoswitch located in the motor case is provided to shut off the motor in case of an overheat

condition. An override function of the control switch in the flight compartment is provided to override the thermoswitch for emergency operation.

(8) The centrifugal boost pump impeller is located on the drive shaft between the motor and the variable displacement pump. The impeller draws hydraulic fluid from the system and supplies it through an external tube to the inlet port of the variable displacement pump under pressure, thereby helping to prevent cavitation of the pump.

(9) The variable displacement hydraulic pump consists of the following major parts: a four piece housing, drive shaft with impeller, axial cylinder barrel containing 9 pistons, pivoting hanger with an inclined camface, hold down plate, pressure compensating valve, and bearings.

(10) When the electric motor is actuated, the drive shaft rotates the boost pump impeller and the cylinder and piston group. Each revolution of the cylinder causes one complete stroke of each piston. The pistons are held against the camface of the hanger by the hold down plate, providing positive piston return. The displacement of fluid from the pump discharge port is controlled by the compensator valve. The pump provides full flow of 3.7 gpm at system pressures up to approximately 2700 psi. At this point, the compensator valve reduces flow until at approximately 3000 psi, displacement of fluid is reduced to zero.

B. Auxiliary Hydraulic Pump Alternate Reservoir

(1) The auxiliary hydraulic pump alternate reservoir is installed on the shear web in the left wing root area, immediately aft of the auxiliary hydraulic pump. Access to the reservoir is through the left wing root access door. The alternate reservoir supplies hydraulic fluid to the auxiliary hydraulic pump in the event the fluid supply from the main hydraulic system reservoir is exhausted.

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(2) The reservoir is cylindrical in shape and has a fluid capacity of approximately 1.9 US gallons (1.6 Imperial gallons or 7.3 liters). There are four ports on the reservoir: an outlet port to the auxiliary hydraulic pump selector valve located at the bottom, an inlet port from the auxiliary hydraulic pump bypass located near the top on the side, an inlet from the wing flap return line, and an outlet to the main hydraulic reservoir located at the top. A sight gage is installed near the top of the reservoir for visual indication of fluid level, and a mounting boss for the emergency hydraulic level indicating light switch is installed on the side of the reservoir.

(3) The reservoir is kept full during operation by routing fluid from the wing flap return line to the reservoir. Fluid in excess of the alternate reservoir capacity is then routed to the main hydraulic system reservoir. Hydraulic fluid from the auxiliary pump bypass is routed to the alternate reservoir and then to the main reservoir. Fluid is used from the alternate reservoir only when the auxiliary pump is operating and the auxiliary pump supply selector valve is in the alternate position. Fluid supply to the alternate reservoir is replenished whenever the wing flaps are operated.

C. Auxiliary Hydraulic Pump Supply Selector Valve (See Figure 2.)

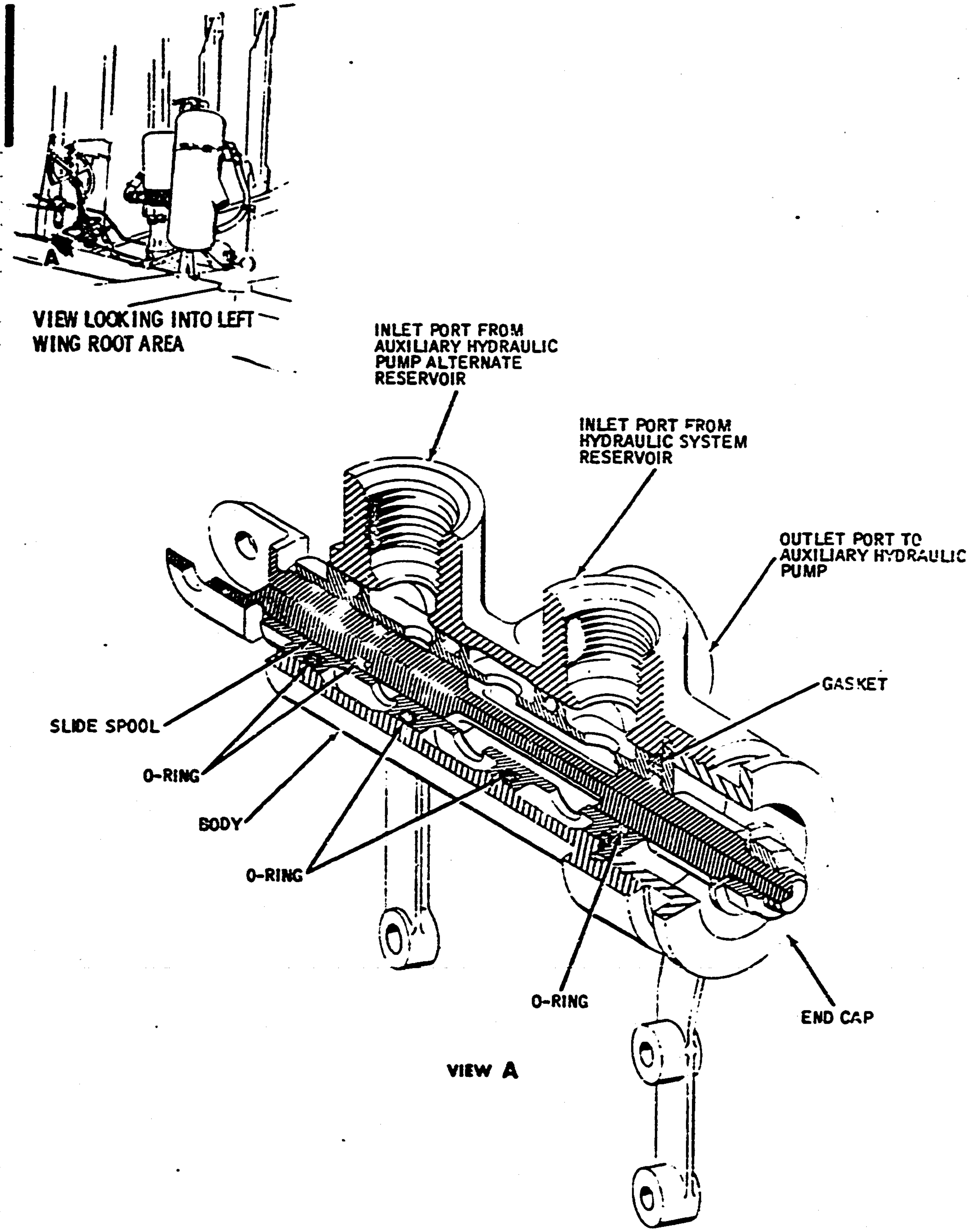
(1) The auxiliary hydraulic pump supply valve is a 2-position valve that ports hydraulic fluid from the reservoir, through a common outlet, to the auxiliary pump. The selector valve is located on the shear web in the left wing root, near the auxiliary pump. The selector valve is accessible through the left wing root access door.

(2) The valve body has two inlet ports and one outlet port. The outlet port is centrally located on the aft side of the valve body. The two inlet ports are located on the outboard side of the valve body, 90 degrees from the outlet port. Two mounting flanges are located on the inboard side of the valve body. These flanges are an integral part of the valve body.

(3) During normal operation, fluid is taken from a low standpipe in the main hydraulic system reservoir and ported to the auxiliary pump. When the valve is in the alternate position, fluid is taken from the auxiliary hydraulic pump alternate reservoir and ported to the auxiliary pump. The valve is moved from the auxiliary position to the alternate position by placing the hydraulic system selector control lever, located on the system engineer's control pedestal, to the general system/main gear downlock and flaps position.

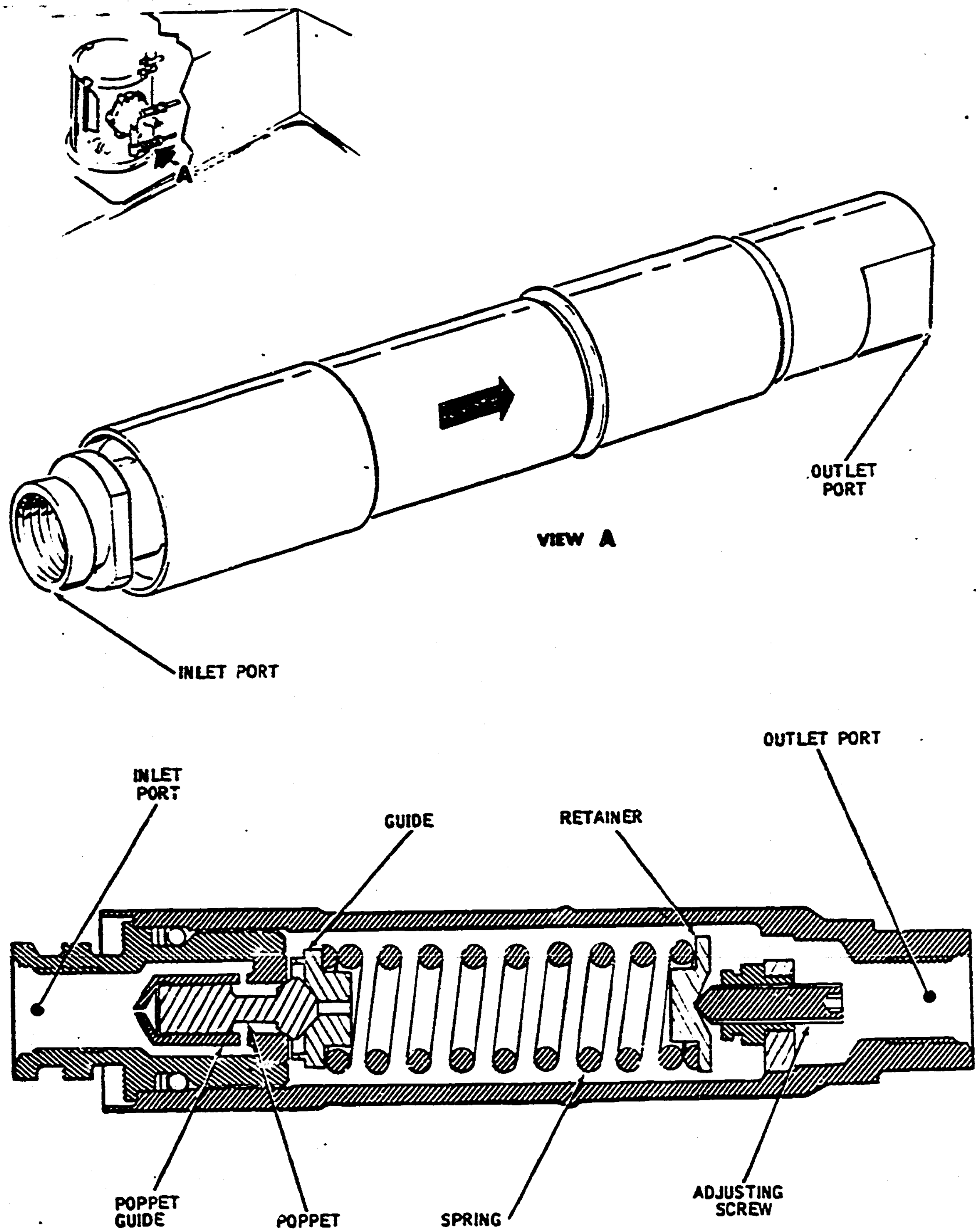
D. Auxiliary Hydraulic Pump Relief Valve (See Figure 3.)

(1) The auxiliary hydraulic pump relief valve is a spring loaded poppet-type valve and serves to relieve excess fluid pressure that may build up in the auxiliary hydraulic system. The relief valve connects, through a reducer, to a tee in the A return port of the hydraulic system reservoir. The valve is accessible through the left wing root access door.



HA2-160A

Auxiliary Hydraulic Pump Supply Selector Valve -- Cutaway View
Figure 2



HA2-161

Auxiliary Hydraulic Pump Relief
Valve -- Cutaway View
Figure 3

(2) Externally, the valve body is cylindrical, approximately 5 inches in length, and 1 inch in diameter. The outlet end of the valve is slightly larger than the inlet end.

(3) When pressure builds up, the poppet starts to relieve at approximately 3300 psi. If pressure continues to build up, the poppet continues to open until 3500 psi and a maximum flow of 3.5 gpm are reached. When pressure is relieved, the poppet reseats at 90 percent of the unseat pressure.

E. Auxiliary Hydraulic System Filter (See Figure 4.)

(1) A line-type, 10-micron filter assembly is installed in the piping of the auxiliary system to filter fluid from the pressure outlet port of the auxiliary pump to the system selector valve. The filter is located on the bulkhead near the forward inboard corner of the left main gear wheel well, slightly inboard and above the dual filter and relief valve. It is accessible through the left main gear inboard door.

(2) The inlet and outlet ports of the filter are internally threaded and are marked in and out. The filter bowl is cylindrical in shape, with wrench flats at the lower end, and is threaded into the assembly immediately below the ports. A hex-shaped magnetic plug is installed in the drain port. The filter element is stainless steel mesh, supported by a perforated cylindrical center core.

F. Auxiliary Hydraulic System Check Valve

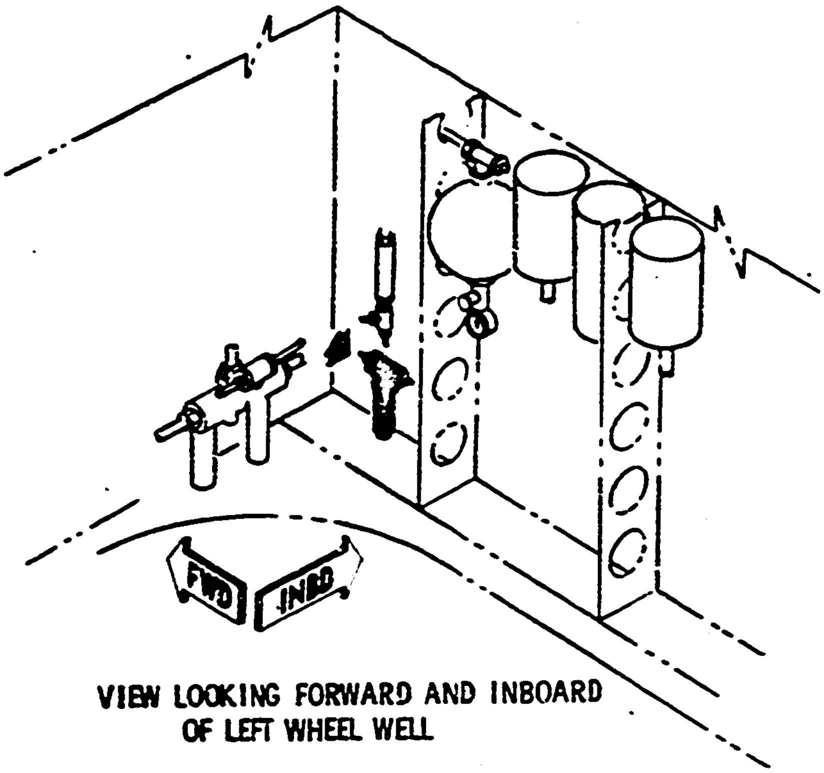
(1) The auxiliary hydraulic system check valve is a spring-loaded, poppet-type valve with a rated capacity of 3000 psi. This valve is installed in the line between the auxiliary hydraulic system filter and the system selector valve to prevent reverse flow of hydraulic fluid through the filter and the auxiliary pump when the engine-driven pumps or external pressure supply are used.

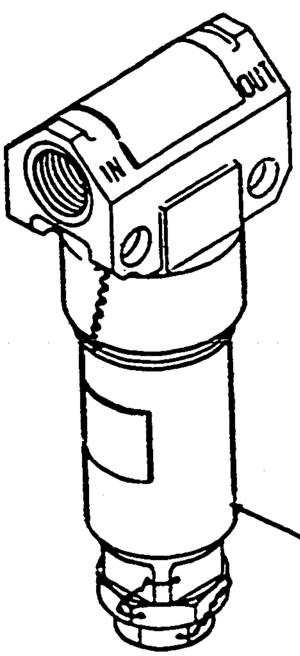
(2) The auxiliary hydraulic system check valve is located in the left wheel well, just above the dual filter and relief valve. The auxiliary hydraulic system check valve is accessible through the left wheel well.

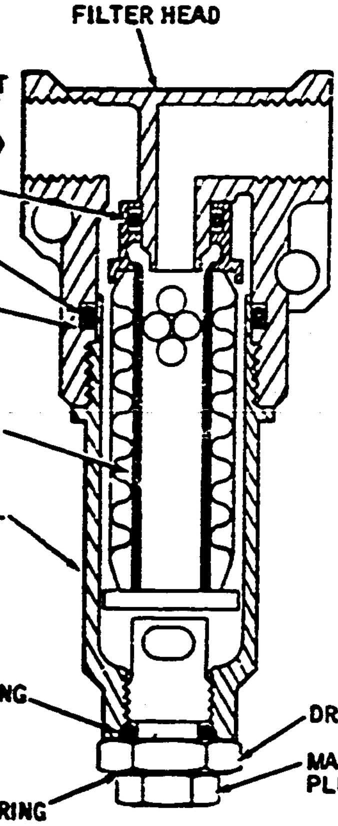
(3) Externally and internally, this valve is similar to the engine-driven hydraulic pump check valve, except for size.

G. Auxiliary Hydraulic System Surge Damper Accumulator (See Figure 5.)

(1) The auxiliary hydraulic system surge damper accumulator consists of two spherical domes, separated by a diaphragm and held together by a ring nut. An air filler valve and gage are installed on the accumulator. The accumulator is installed in the auxiliary hydraulic pump pressure line just inboard and aft of the auxiliary pump, and is attached to the shear web by two clamp blocks. Access to the accumulator is through the left wing root access door.







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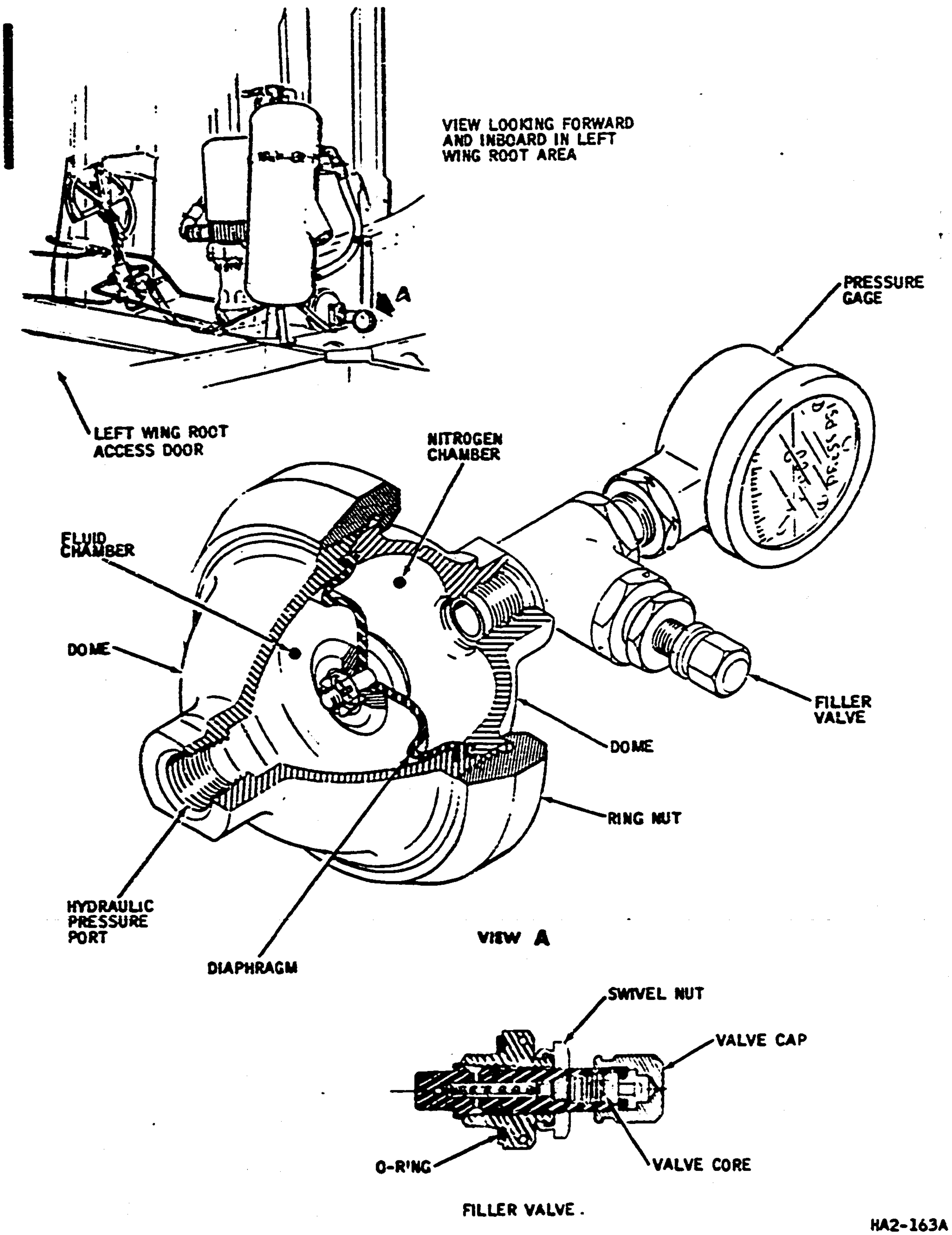
Auxiliary Hydraulic System Filter -- Cutaway View
Figure 4



Auxiliary Hydraulic Power System Surge Damper
Accumulator -- Cutaway View
Figure 5

(2) The accumulator is initially charged to 1000 psi with dry nitrogen. As the auxiliary system pressure builds up, fluid is forced against the diaphragm in the accumulator, further compressing the trapped nitrogen in the air side of the accumulator to full system pressure (2600 to 3000 psi is indicated on the accumulator pressure gage). The air in the accumulator absorbs the initial shock of the auxiliary pump output and permits the system pressure to rise gradually. The accumulator also serves to cushion the piping and system components against high impact loads.

H. Auxiliary Hydraulic Pump Control

(1) The auxiliary hydraulic pump control system consists of auxiliary hydraulic pump control switch, an auxiliary hydraulic pump control relay, an auxiliary hydraulic pump power relay, an electric motor, and an auxiliary pump on indicating light.

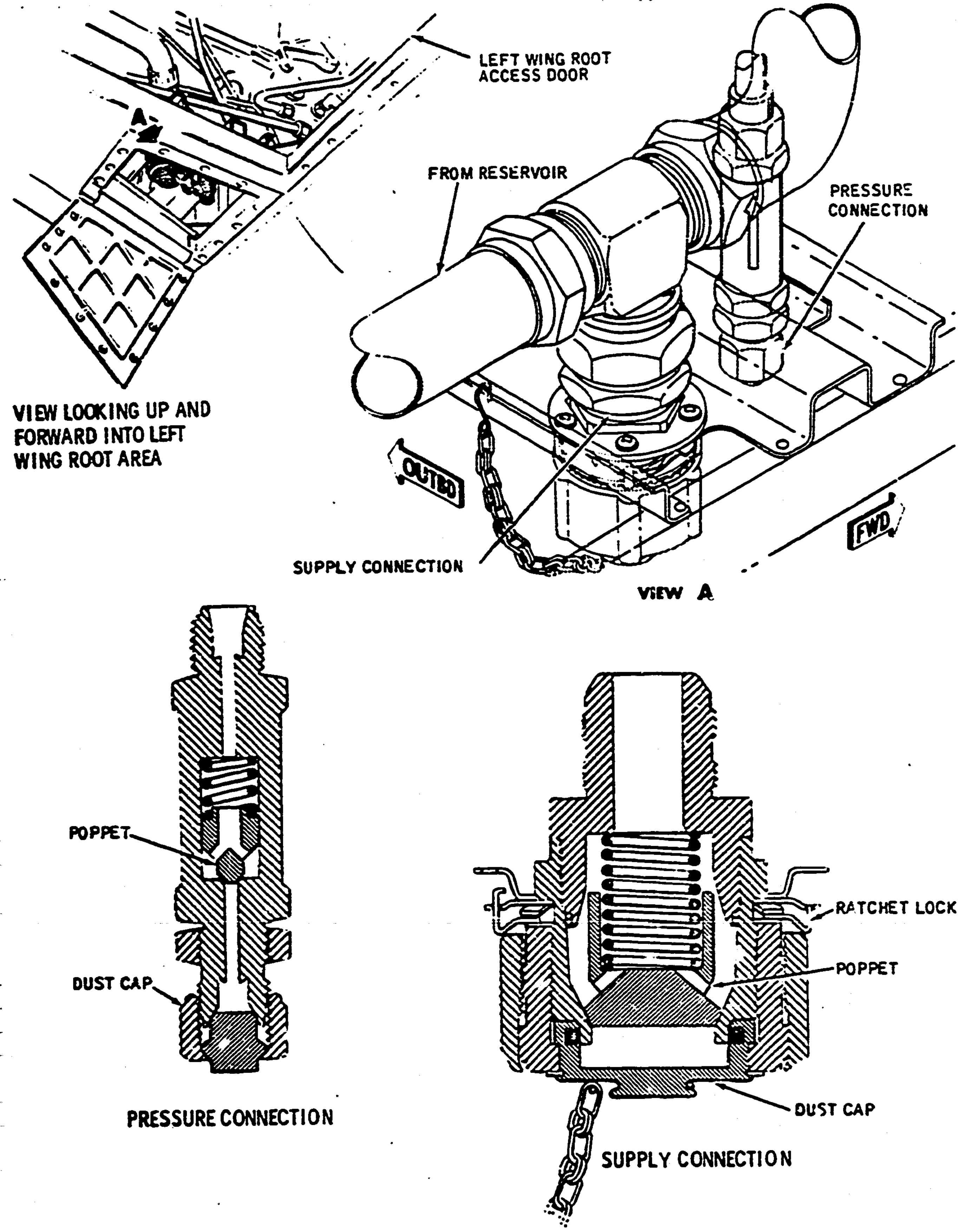
(2) Two auxiliary hydraulic pump control switches are located in the flight compartment. A third switch is located in the left wing root area, directly aft of the auxiliary hydraulic pump. This switch is for the convenience of ground crew personnel during maintenance operations. The switches are spring-loaded to the center (off) position and have two momentary positions placarded start (hold only in emergency) and stop.

(3) The electric motor for the auxiliary hydraulic pump is an ac, 3-phase motor. A thermostatic switch is included in the circuit to protect the motor from overheating.

(4) The auxiliary hydraulic pump motor is supplied with power from the cabin bus 4. This permits pump operation from an external power source or from the airplane electrical system.

(5) The auxiliary pump on indicating light is a blue press-to-test light, located adjacent to the auxiliary hydraulic pump control switch. The light is equipped with a dimming feature.

(6) When any one of the auxiliary hydraulic pump control switches is momentarily moved to the start position, the circuitry is completed between the auxiliary hydraulic pump control relay and cabin bus 4. The ground is through the stop contact of the switch and the thermostatic switch of the motor. Once the relay is energized, it remains energized through its own holding contacts. Through a closed contact of the pump control relay, power is supplied from cabin bus 4 to energize the hydraulic pump power relay. Through the closed contacts of the pump power relay, a power circuit is completed from the feeder leads of cabin bus 4 to the auxiliary hydraulic pump motor. The blue indicating light, located in the flight compartment, receives power through one of the closed contacts of the pump power relay. Therefore, the light is on whenever the pump power relay is energized.



Ground Power Connectors -- Cutaway View
Figure 6

(7) The auxiliary hydraulic pump motor is safeguarded against overheating by the thermostatic switch. Under normal conditions, this switch is in the ground leg of the control relay. When an overheat condition occurs, the thermostatic switch opens the control relay circuit to limit the motor case to 450°F (252°C). This action deenergizes the control relay, which in turn denergizes the power relay. In an emergency situation, the thermostatic switch can be overridden by holding the auxiliary hydraulic pump control switch in the start (hold only in emergency) position.

(8) When the auxiliary hydraulic pump control switch is placed in the momentary stop position, the ground for the control relay is broken, deenergizing the power relay and removing power from the pump motor and the indicating light.

I. Ground Service Pressure and Supply Connectors (See Figure 6.)

(1) The ground service pressure and supply connectors are external fittings to which a service unit can be connected for operating the hydraulic power system when there is no power on the airplane. The connectors are located on a panel covered by an access door on the lower skin of the left wing root, aft of the rear spar.

(2) The ground service pressure connector is made up of a check valve with a flared, bulkhead-type fitting on the inlet end and a standard tube fitting on the outlet end which connects to the left engine-driven pump pressure line. The inlet fitting is covered with a dust cap when not in use.

(3) The internal description of the connector is the same as that of the engine-driven hydraulic pump check valve (see 29-10-0, Description and Operation). The connector operates as a shutoff valve when the ground unit is not connected. When a ground hydraulic power source is connected to the pressure connector and pressure is applied, the poppet unseats and supplies pressure fluid to the hydraulic power system.

(4) The supply connector is made up of a T-fitting and a self-sealing coupling half. The tee is female-threaded to accept the bulkhead-type fitting on the upper end of the coupling. The cross arms of the tee tie into the right engine-driven pump supply line with flared-type fittings. The tee is threaded onto the coupling half and is secured with a locknut. The coupling consists of a coupling body, male-threaded to accept the coupling half from the ground source. The mounting flange has a recess to accept the hex portion of the coupling body, and has notches to retain the lockspring. A dust cap consisting of a union nut assembly, a dust plug, and a securing chain is installed on the lower end of the coupling when not in use.

AUXILIARY - DESCRIPTION AND OPERATION

1. General

A. The auxiliary hydraulic system is a supplementary hydraulic power system connected to the main hydraulic power system through the system selector valve and the auxiliary pump supply selector valve. The auxiliary hydraulic system consists of an electrically driven auxiliary hydraulic pump, an auxiliary pump relief valve, a surge damper accumulator, an auxiliary filter and check valve, and the piping required to interconnect the components and connect the auxiliary system to the main power system.

B. In flight, the auxiliary hydraulic system can be used as supplemental power for the main power system. The auxiliary pump will also serve, when ground support equipment is not available, to pressurize the hydraulic power system for ground testing of the airplane hydraulic subsystems and components. Fluid is supplied to the auxiliary pump from a low standpipe in the hydraulic system reservoir. When the auxiliary pump is operated, fluid from the pressure outlet port of the auxiliary pump is ported, through the auxiliary power system filter and an auxiliary system check valve, to the auxiliary pressure inlet port of the system selector valve. When the system selector valve is in the normal position, auxiliary pump pressure is ported to the general system.

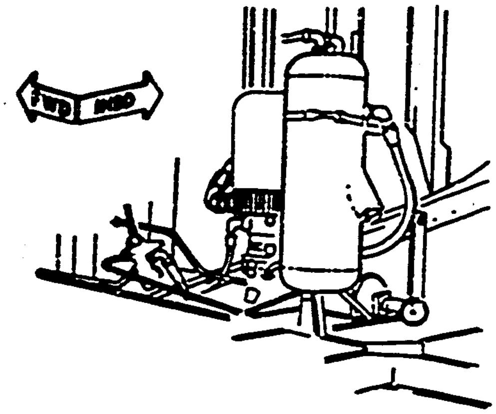
C. When the auxiliary pump is not operating, the auxiliary system check valve prevents reverse flow through the auxiliary pump from the engine-driven pumps. An auxiliary pump relief valve is teed into the line from the auxiliary pump outlet port to the reservoir filter inlet port. The valve relieves and ports excess fluid pressure back to the reservoir if auxiliary pressure builds above 3300 psi.

D. The auxiliary pump alternate reservoir is installed in the auxiliary hydraulic system to provide an alternate hydraulic fluid source in case of depletion of the normal supply to the hydraulic system reservoir. The alternate reservoir source is selectable by operation of the auxiliary hydraulic pump supply selector valve which actuates simultaneously with the hydraulic system selector valve.

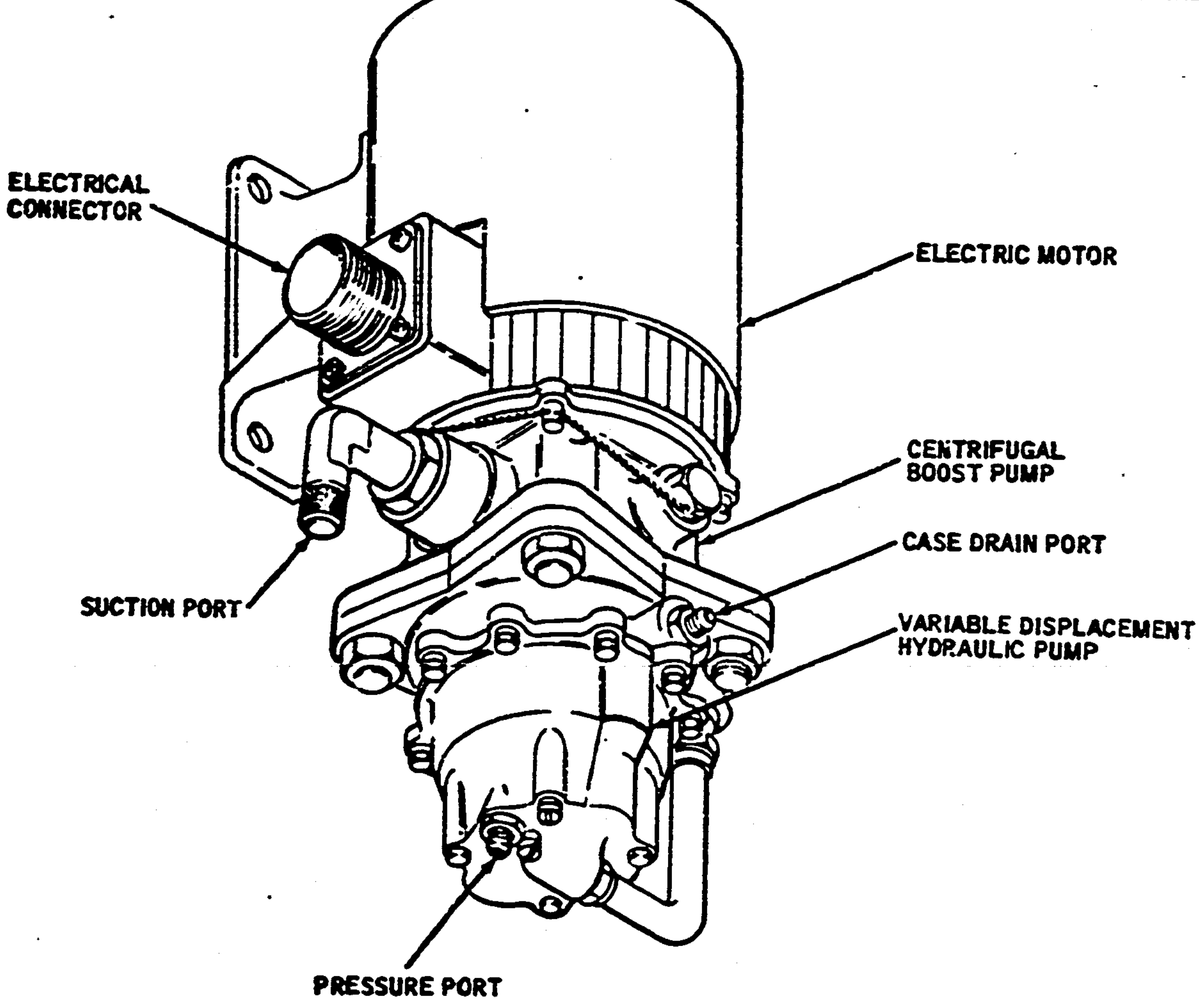
2. System Components

A. Auxiliary Hydraulic Pump (See Figure 1.)

(1) The auxiliary hydraulic pump, located in the left wing root access area, supplies hydraulic pressure for the auxiliary hydraulic system. The pump consists of an air cooled electric motor directly coupled through a shaft and centrifugal boost pump impeller to a variable displacement hydraulic pump.



VIEW LOOKING FORWARD AND
INBOARD AT LEFT WING ROOT AREA



HA2-5780

Auxiliary Hydraulic Pump
Figure 1

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(2) The electric motor is a 115/200-volt, 3-phase, 400-cps, continuous duty motor. The motor rotor has an internally splined output shaft which fits on the externally splined input shaft of the pump. The other end of the rotor shaft drives a cooling fan which forces cooling air between the motor case and the outer shroud. A thermoswitch located in the motor case is provided to shut off the motor in case of an overheat condition. An override function of the control switch in the flight compartment is provided to override the thermoswitch for emergency operation.

(3) The centrifugal boost pump impeller is located on the drive shaft between the motor and the variable displacement pump. The impeller draws hydraulic fluid from the system and supplies it through an external tube to the inlet port of the variable displacement pump under pressure, thereby helping to prevent cavitation of the pump.

(4) The variable displacement hydraulic pump consists of the following major parts: a four piece housing, drive shaft with impeller, axial cylinder barrel containing 9 pistons, pivoting hanger with an inclined camface, hold down plate, pressure compensating valve, and bearings.

(5) When the electric motor is actuated, the drive shaft rotates the boost pump impeller and the cylinder and piston group. Each revolution of the cylinder causes one complete stroke of each piston. The pistons are held against the camface of the hanger by the hold down plate, providing positive piston return. The displacement of fluid from the pump discharge port is controlled by the compensator valve. The pump provides full flow of 3.7 gpm at system pressures up to approximately 2700 psi. At this point, the compensator valve reduces flow until at approximately 3000 psi, displacement of fluid is reduced to zero.

B. Auxiliary Hydraulic Pump Alternate Reservoir

(1) The auxiliary hydraulic pump alternate reservoir is installed on the shear web in the left wing root area, immediately aft of the auxiliary hydraulic pump. Access to the reservoir is through the left wing root access door. The alternate reservoir supplies hydraulic fluid to the auxiliary hydraulic pump in the event the fluid supply from the main hydraulic system reservoir is exhausted.

(2) The reservoir is cylindrical in shape and has a fluid capacity of approximately 1.9 US gallons (1.6 Imperial gallons or 7.3 liters). There are four ports on the reservoir: an outlet port to the auxiliary hydraulic pump selector valve located at the bottom, an inlet port from the auxiliary hydraulic pump case drain located near the top on the side, an inlet from the wing flap return line, and an outlet to the main hydraulic reservoir located at the top. A sight gage is installed near the top of the reservoir for visual indication of fluid level, and a mounting boss for the emergency hydraulic level indicating light switch is installed on the side of the reservoir.

(3) The reservoir is kept full during operation by routing fluid from the wing flap return line to the reservoir. Fluid in excess of the alternate reservoir capacity is then routed to the main hydraulic reservoir. Hydraulic fluid from the auxiliary pump case drain is routed to the alternate reservoir and then to the main reservoir. Fluid is used from the alternate reservoir only when the auxiliary pump is operating and the auxiliary pump supply selector valve is in the alternate position. Fluid supply to the alternate reservoir is replenished whenever the wing flaps are operated.

C. Auxiliary Hydraulic Pump Supply Selector Valve (See Figure 2.)

(1) The auxiliary hydraulic pump supply valve is a 2-position valve that ports hydraulic fluid from either reservoir, through a common outlet, to the auxiliary pump. The selector valve is located on the shear web in the left wing root, near the auxiliary pump. The selector valve is accessible through the left wing root access door.

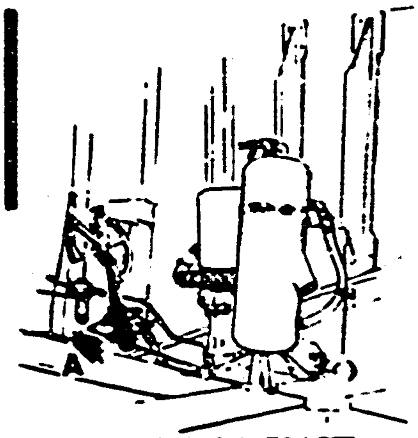
(2) The valve body has two inlet ports and one outlet port. The outlet port is centrally located on the aft side of the valve body. The two inlet ports are located on the outboard side of the valve body, 90 degrees from the outlet port. Two mounting flanges are located on the inboard side of the valve body. These flanges are an integral part of the valve body.

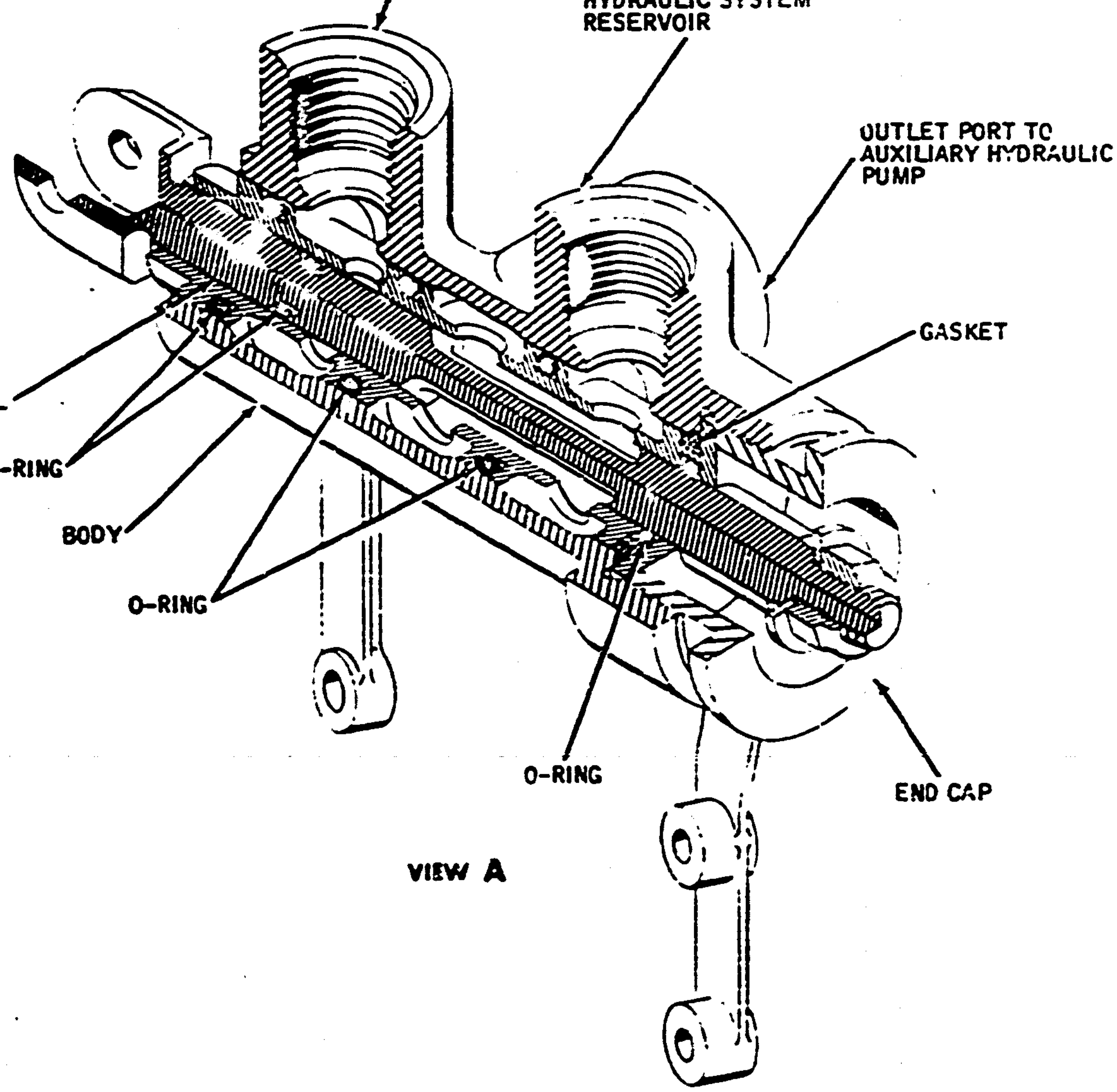
(3) During normal operation, fluid is taken from a low standpipe in the main hydraulic system reservoir and ported to the auxiliary pump. When the valve is in the alternate position, fluid is taken from the auxiliary hydraulic pump alternate reservoir and ported to the auxiliary pump. The valve is moved from the auxiliary position to the alternate position by placing the hydraulic system selector control lever, located on the system engineer's control pedestal, to the general system/main gear downlock and flaps position.

D. Auxiliary Hydraulic Pump Relief Valve (See Figure 3.)

(1) The auxiliary hydraulic pump relief valve is a spring loaded poppet-type valve and serves to relieve excess fluid pressure that may build up in the auxiliary hydraulic system. The relief valve connects, through a reducer, to a tee in the A return port of the hydraulic system reservoir. The valve is accessible through the left wing root access door.

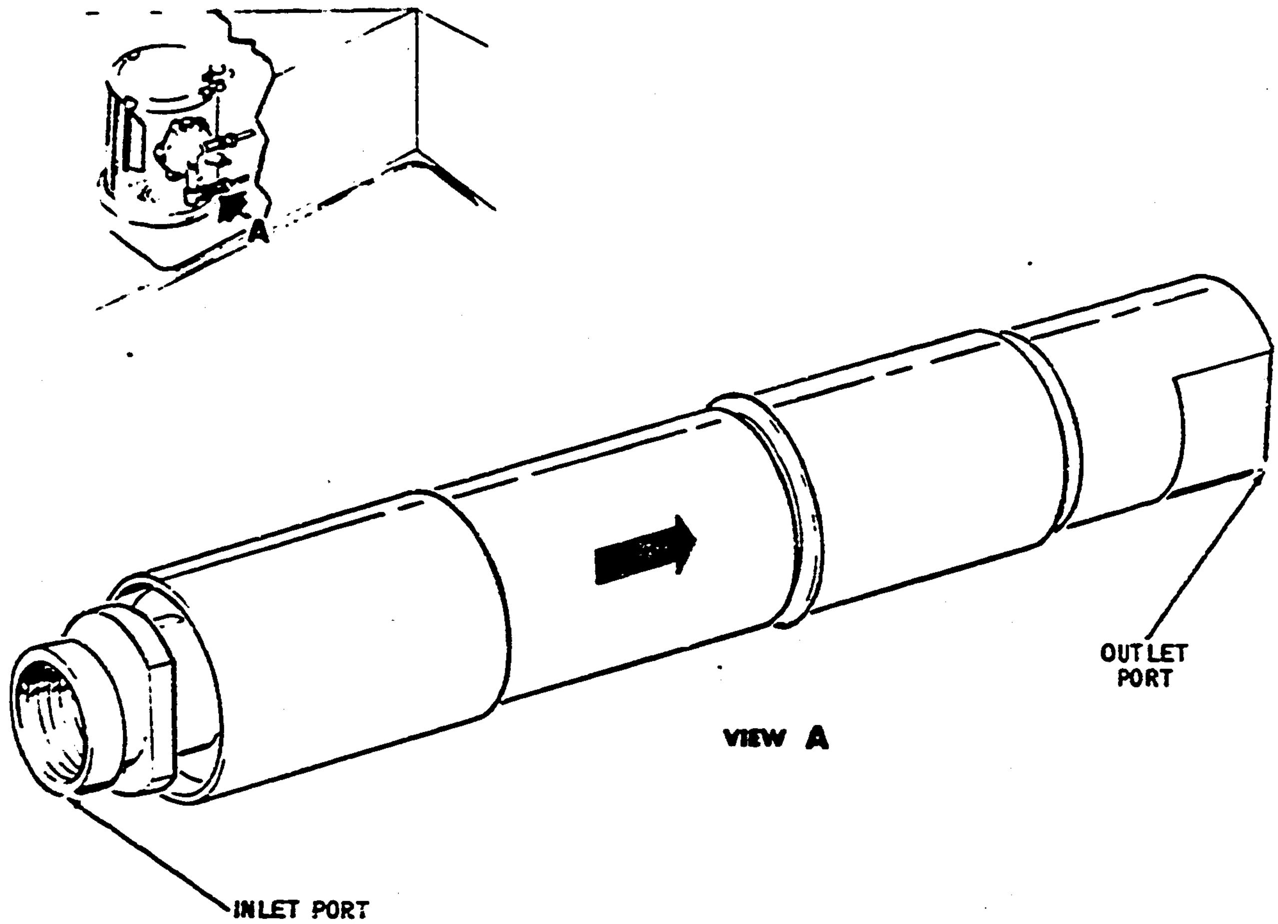
(2) Externally, the valve body is cylindrical, approximately 5 inches in length, and 1 inch in diameter. The outlet end of the valve is slightly larger than the inlet end.

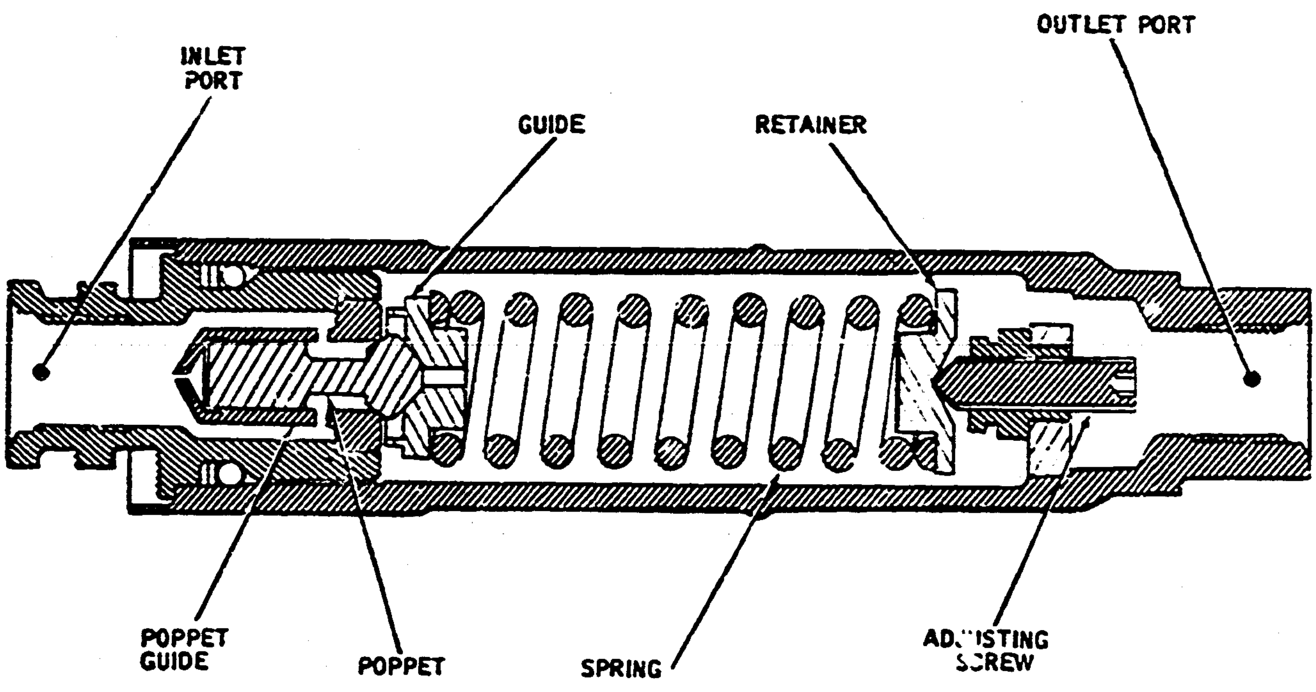




HA2-160A

Auxiliary Hydraulic Pump Supply Selector
Valve -- Cutaway View
Figure 2





HA2-161

Auxiliary Hydraulic Pump Relief Valve -- Cutaway View
Figure 3

(3) When pressure builds up, the poppet starts to relieve at approximately 3300 psi. If pressure continues to build up, the poppet continues to open until 3500 psi and a maximum flow of 3.5 gpm are reached. When pressure is relieved, the poppet reseats at 90 percent of the unseat pressure.

E. Auxiliary Hydraulic System Filter (See Figure 4.)

(1) A line-type, 10 micron filter assembly is installed in the piping of the auxiliary system to filter fluid from the pressure outlet port of the auxiliary pump to the system selector valve. The filter is located on the bulkhead near the forward inboard corner of the left main gear wheel well, slightly inboard and above the dual filter and relief valve. It is accessible through the left main gear inboard door.

(2) The inlet and outlet ports of the filter are internally threaded and are marked in and out. The filter bowl is cylindrical in shape, with wrench flats at the lower end, and is threaded into the assembly immediately below the ports. A hex-shaped magnetic plug is installed in the drain port. The filter element is stainless steel mesh, supported by a perforated cylindrical center core.

F. Auxiliary Hydraulic System Check Valve

(1) The auxiliary hydraulic system check valve is a spring-loaded, poppet-type valve with a rated capacity of 3000 psi. This valve is installed in the line between the auxiliary hydraulic system filter and the system selector valve to prevent reverse flow of hydraulic fluid through the filter and the auxiliary pump when the engine-driven pumps or external pressure supply are used.

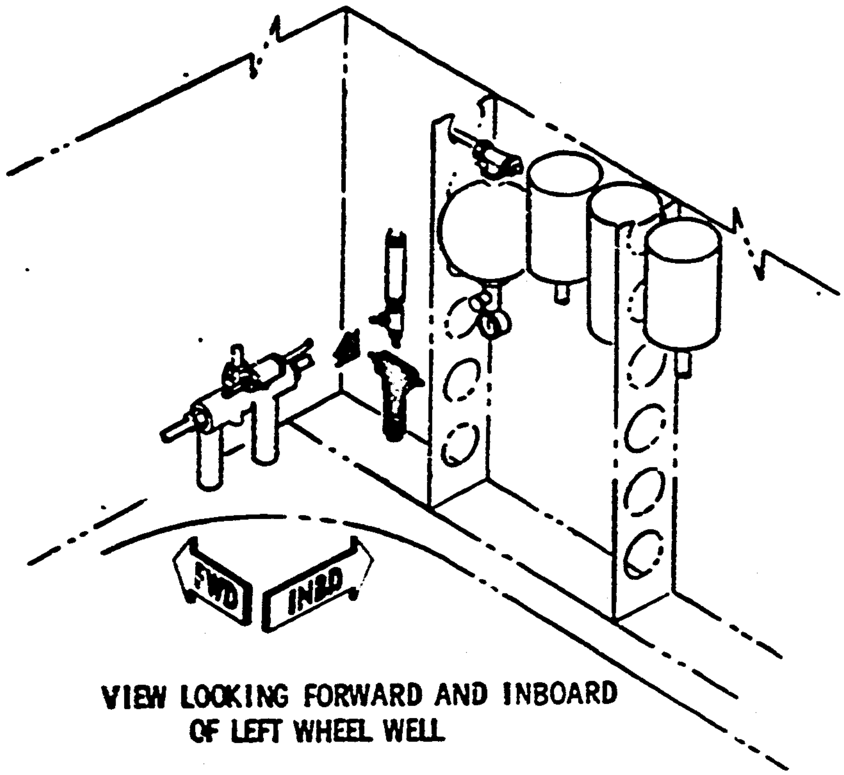
(2) The auxiliary hydraulic system check valve is located in the left wheel well, just above the dual filter and relief valve. The auxiliary hydraulic system check valve is accessible through the left wheel well.

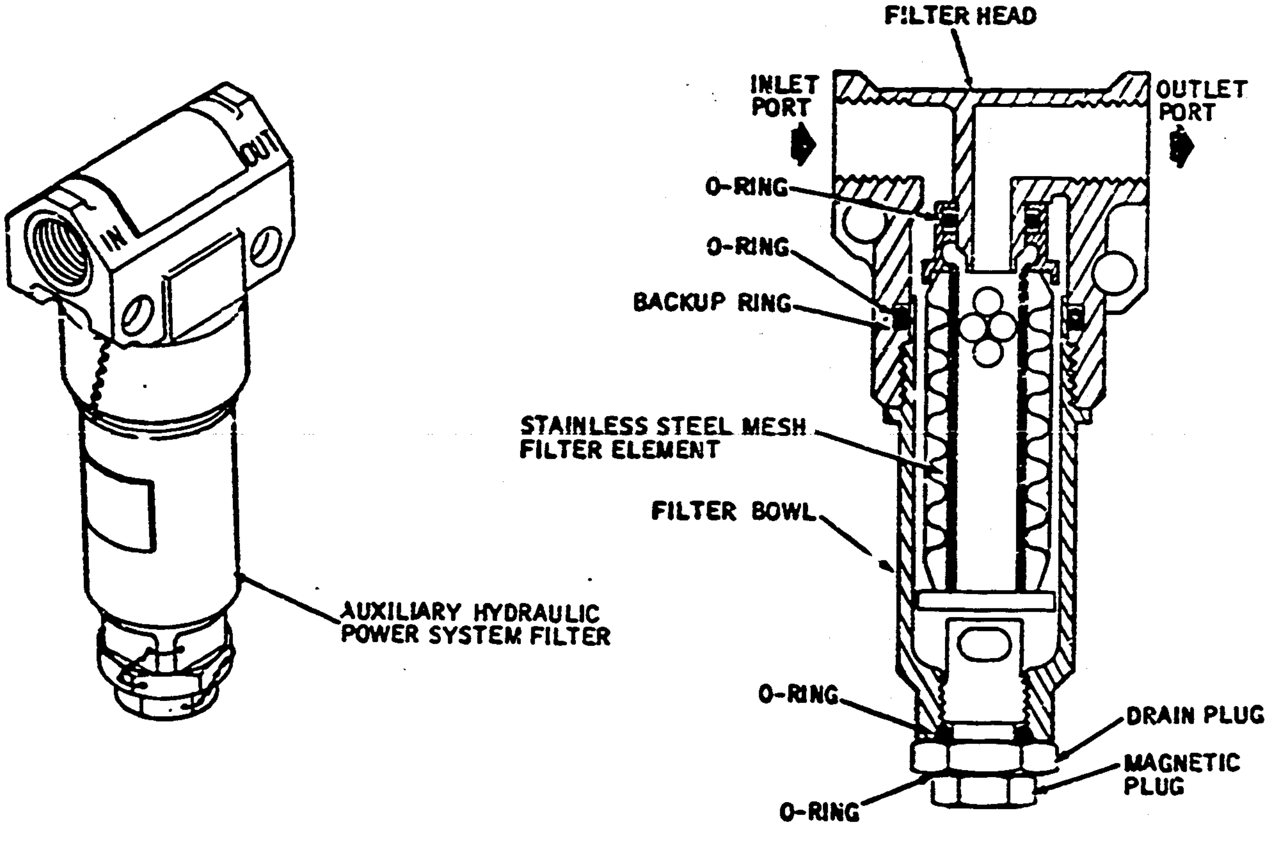
(3) Externally and internally, this valve is similar to the engine-driven hydraulic pump check valve, except for size.

G. Auxiliary Hydraulic System Surge Damper Accumulator (See Figure 5.)

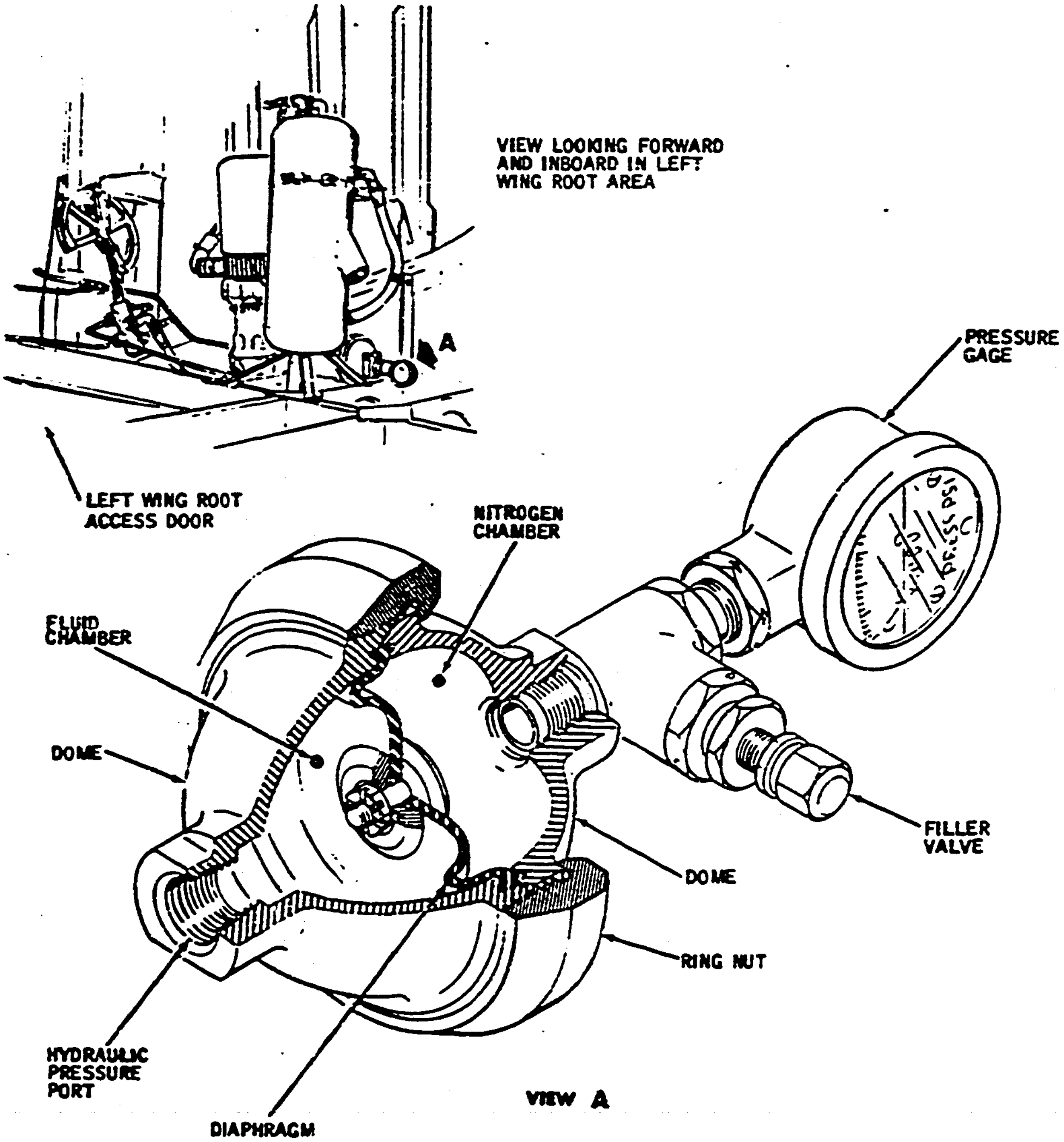
(1) The auxiliary hydraulic system surge damper accumulator consists of two spherical domes, separated by a diaphragm and held together by a ring nut. An air filler valve and gage are installed on the accumulator. The accumulator is installed in the auxiliary hydraulic pump pressure line just inboard and aft of the auxiliary pump, and is attached to the shear web by two clamp blocks. Access to the accumulator is through the left wing root access door.

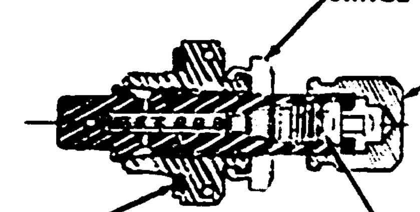
(2) The accumulator is initially charged to 1000 psi with dry nitrogen. As the auxiliary system pressure builds up, fluid is forced against the diaphragm in the accumulator, further compressing the trapped nitrogen





Auxiliary Hydraulic System Filter -- Cutaway View
Figure 4





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Auxiliary Hydraulic Power System Surge Damper
Accumulator -- Cutaway View
Figure 5

in the air side of the accumulator to full system pressure (2600 to 3000 psi is indicated on the accumulator pressure gage). The air in the accumulator absorbs the initial shock of the auxiliary pump output and permits the system pressure to rise gradually. The accumulator also serves to cushion the piping and system components against high impact loads.

H. Auxiliary Hydraulic Pump Control

(1) The auxiliary hydraulic pump control system consists of auxiliary hydraulic pump control switch, an auxiliary hydraulic pump control relay, an auxiliary hydraulic pump power relay, an electric motor, and an auxiliary pump on indicating light.

(2) The auxiliary hydraulic pump control switch(es), located in the flight compartment, are 3-position switches. They are spring-loaded to the center position and have two momentary positions placarded start (hold only in emergency) and stop.

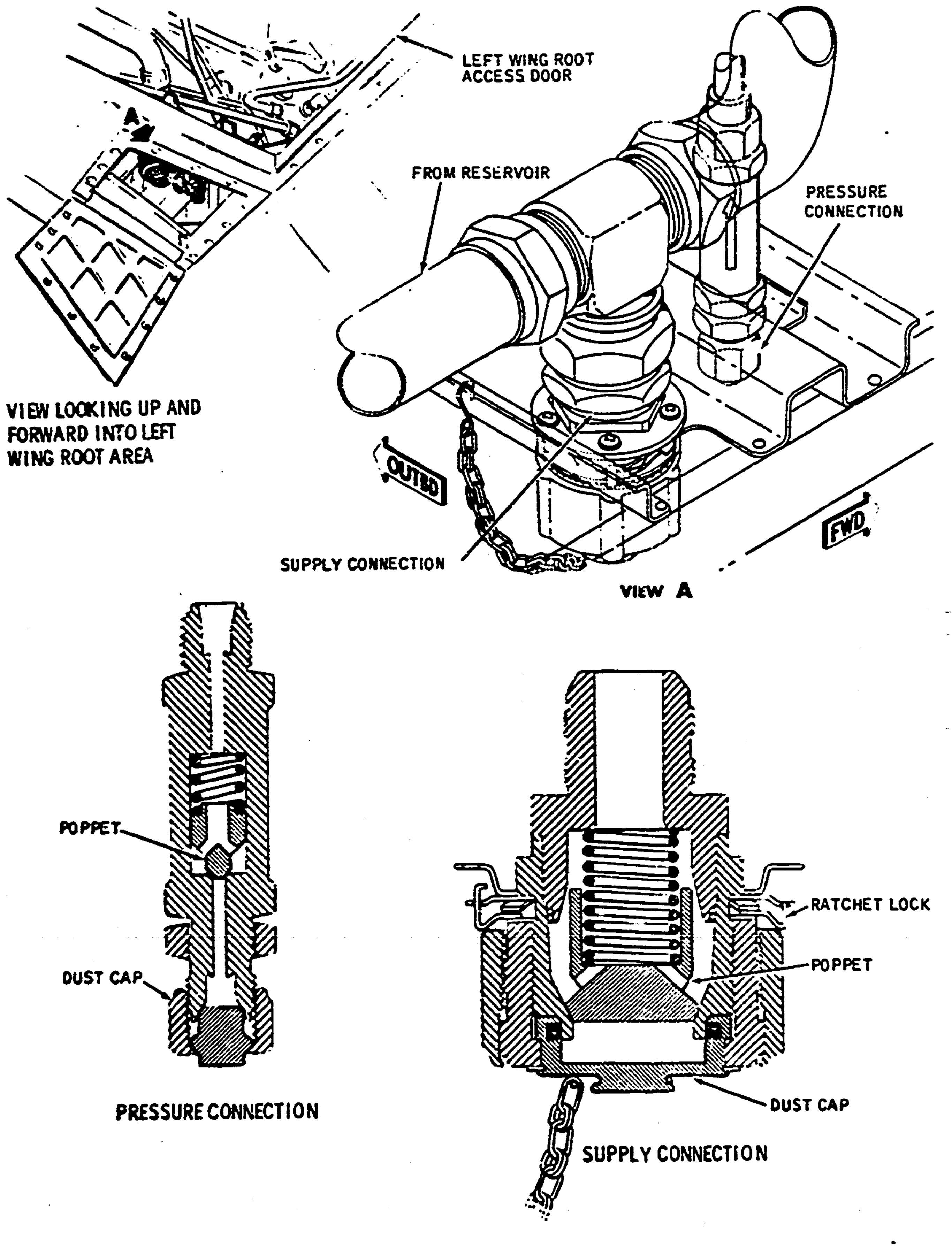
(3) The electric motor for the auxiliary hydraulic pump is an ac, 3-phase motor. A thermostatic switch is included in the circuit to protect the motor from overheating.

(4) The auxiliary hydraulic pump motor is supplied with power from the cabin bus 4. This permits pump operation from an external power source or from the airplane electrical system.

(5) The auxiliary pump on indicating light is a blue press-to-test light, located adjacent to the auxiliary hydraulic pump control switch. The light is equipped with a dimming feature.

(6) When the auxiliary hydraulic pump control switch is momentarily moved to the start position, the circuitry is completed between the auxiliary hydraulic pump control relay and cabin bus 4. The ground is through the stop contact of the switch and the thermostatic switch of the motor. Once the relay is energized, it remains energized through its own holding contacts. Through a closed contact of the pump control relay, power is supplied from cabin bus 4 to energize the hydraulic pump power relay. Through the closed contacts of the pump power relay, a power circuit is completed from the feeder leads of cabin bus 4 to the auxiliary hydraulic pump motor. The blue indicating light, located in the flight compartment, receives power through one of the closed contacts of the pump power relay. Therefore, the light is on whenever the pump power relay is energized.

(7) The auxiliary hydraulic pump motor is safeguarded against overheating by the thermostatic switch. Under normal conditions, this switch is in the ground leg of the control relay. When an overheat condition occurs, the thermostatic switch opens the control relay circuit to limit the motor case to 450°F (252°C). This action deenergizes the control relay, which in turn deenergizes the power relay. In an emergency situation, the



Ground Power Connectors -- Cutaway View
Figure 6

thermostatic switch can be overridden by holding the auxiliary hydraulic pump control switch in the start (hold only in emergency) position.

(8) When the auxiliary hydraulic pump control switch is placed in the momentary stop position, the ground for the control relay is broken, deenergizing the power relay and removing power from the pump motor and the indicating light.

I. Ground Service Pressure and Supply Connectors (See Figure 6.)

(1) The ground service pressure and supply connectors are external fittings to which a service unit can be connected for operating the hydraulic power system when there is no power on the airplane. The connectors are located on a panel covered by an access door on the lower skin of the left wing root, aft of the rear spar.

(2) The ground service pressure connector is made up of a check valve with a flared, bulkhead-type fitting on the inlet end and a standard tube fitting on the outlet end which connects to the left engine-driven pump pressure line. The inlet fitting is covered with a dust cap when not in use.

(3) The internal description of the connector is the same as that of the engine-driven hydraulic pump check valve (see 29-10-0 Description and Operation). The connector operates as a shutoff valve when the ground unit is not connected. When a ground hydraulic power source is connected to the pressure connector and pressure is applied, the poppet unseats and supplies pressure fluid to the hydraulic power system.

(4) The supply connector is made up of a T-fitting and a self-sealing coupling half. The tee is female-threaded to accept the bulkhead-type fitting on the upper end of the coupling. The cross arms of the tee tie into the right engine-driven pump supply line with flared-type fittings. The tee is threaded onto the coupling half and is secured with a locknut. The coupling consists of a coupling body, male-threaded to accept the coupling half from the ground source. The mounting flange has a recess to accept the hex portion of the coupling body, and has notches to retain the lockspring. A dust cap consisting of a union nut assembly, a dust plug, and a securing chain is installed on the lower end of the coupling when not in use.

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AUXILIARY - DESCRIPTION AND OPERATION

1. General

A. The auxiliary hydraulic system is a supplementary hydraulic power system connected to the main hydraulic power system through the system selector valve and the auxiliary pump supply selector valve. The auxiliary hydraulic system consists of an electrically driven auxiliary hydraulic pump, an auxiliary pump relief valve, a surge damper accumulator, an auxiliary filter and check valve, and the piping required to interconnect the components and connect the auxiliary system to the main power system.

B. In flight, the auxiliary hydraulic system can be used as supplemental power for the main power system. The auxiliary pump will also serve, when ground support equipment is not available, to pressurize the hydraulic power system for ground testing of the airplane hydraulic subsystems and components. Fluid is supplied to the auxiliary pump from a low standpipe in the hydraulic system reservoir. When the auxiliary pump is operated, fluid from the pressure outlet port of the auxiliary pump is ported, through the auxiliary power system filter and an auxiliary system check valve, to the auxiliary pressure inlet port of the system selector valve. When the system selector valve is in the normal position, auxiliary pump pressure is ported to the general system.

C. When the auxiliary pump is not operating, the auxiliary system check valve prevents reverse flow through the auxiliary pump from the engine-driven pumps. An auxiliary pump relief valve is teed into the line from the auxiliary pump outlet port to the reservoir filter inlet port. The valve relieves and ports excess fluid pressure back to the reservoir if auxiliary pressure builds above 3300 psi.

D. The auxiliary pump alternate reservoir is installed in the auxiliary hydraulic system to provide an alternate hydraulic fluid source in case of depletion of the normal supply to the hydraulic system reservoir. The alternate reservoir source is selectable by operation of the auxiliary hydraulic pump supply selector valve which actuates simultaneously with the hydraulic system selector valve.

2. System Components

A. Auxiliary Hydraulic Pump - Airplanes N8070U-N8076U (See Figure 1.)

(1) The auxiliary hydraulic pump is an electrically driven, continuous-duty pressure-compensated, variable-displacement pump. An automatic pressure-sensing mechanism (compensator) within the pump regulates the amount of fluid delivered to the airplane hydraulic system. The quantity of delivery is dependent on the system pressure. Flow is reduced to zero when desired system pressure is achieved.

(2) The internal components of the pump perform three major functions; mechanical drive (motor), fluid displacement (pistons), and pressure control (compensator). Mechanical drive is supplied by a 200-vac, 3-phase, 400-cycle electric motor.

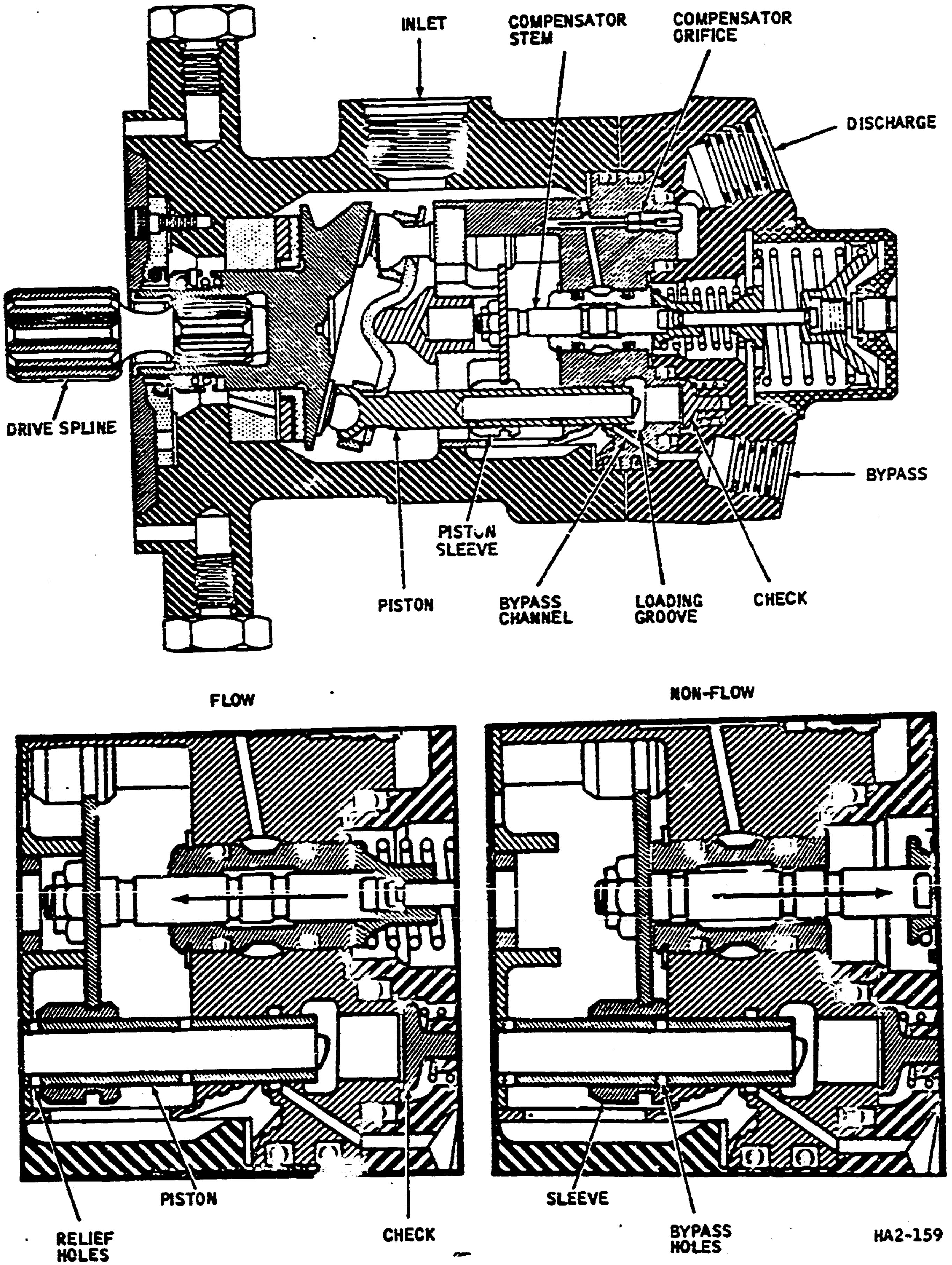
(3) As the hydraulic fluid from the reservoir enters the inlet port, the fluid is displaced by axial piston motion. As a piston advances in a cylinder bore, it forces a quantity of fluid past the pump check at the end of the bore. When the piston bypass holes become aligned hydraulically with the cylinder block passage, pressurized fluid also escapes to bypass; then a combination of spring pressure and system back pressure closes the pump checks. In the withdrawal portion of the piston stroke, a partial vacuum is created in the cylinder bore, allowing new fluid from the intake to flow into the bore from the pressurized reservoir. The quantity of fluid delivered by each piston stroke is controlled by relief holes in the pistons and piston sleeves.

(4) Unless the relief holes are covered by the piston sleeves, no fluid is forced past the pump checks. Quantity of delivery is therefore determined by the position of the piston sleeves, which in turn is determined by system pressure bled through the compensator orifices. Because one sleeve is slightly longer than the others, the pump, even when in full cutoff, continues to pump enough fluid to make up for any minor drop in the system pressure due to leakage.

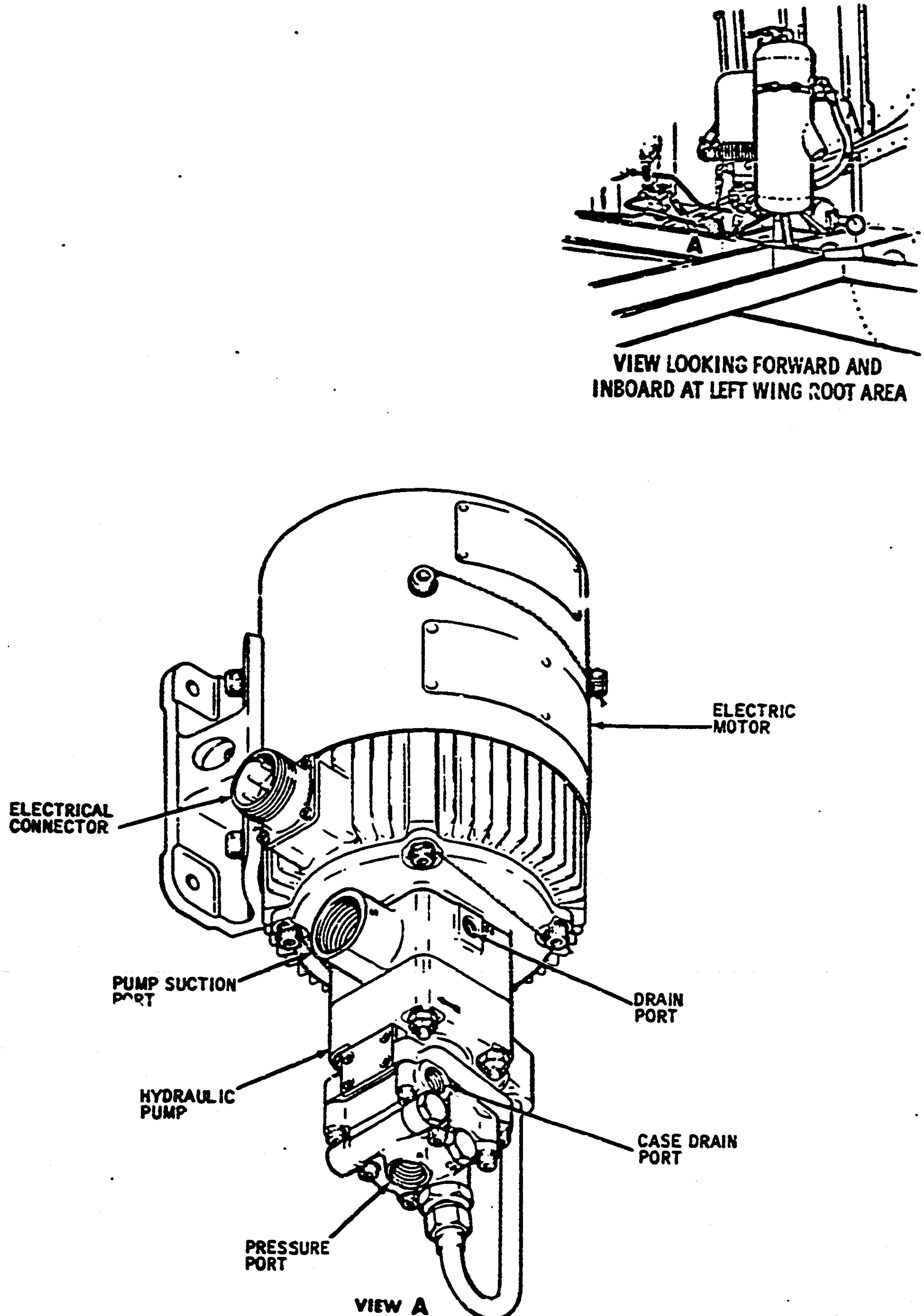
(5) Pressure control: System pressure, acting through the compensator orifice on the compensator stem, controls the piston sleeve position and, therefore, determines whether the pump delivers at full capacity, partial capacity, or cuts off entirely. Path of fluid flow through the pump remains the same in all three conditions. When the pressure at the outlet port reaches 2700 psi, pressure in the compensator commences to reduce the output until 3000 psi is reached, at which time fluid flow is zero. The bypass system is provided to supply self-lubrication, particularly when the pump is in non-delivery (cutoff) operation. The ring of bypass holes in the pistons is hydraulically aligned with the bypass passage each time a piston reaches the very end of it's forward travel period. This pumps a small quantity of fluid out of the bypass passage back to the supply reservoir and provides a constant changing of the fluid in the pump. The bypass is designed to pump against a considerable back pressure for use with pressurized hydraulic reservoirs.

B. Auxiliary Hydraulic Pump - Airplanes N8077U and Subsequent (See Figure 2.)

(1) The auxiliary hydraulic pump, located in the left wing root access area, supplies hydraulic pressure for the auxiliary hydraulic system. The pump consists of an air cooled electric motor directly coupled through a shaft and centrifugal boost pump impeller to a variable displacement hydraulic pump.



Auxiliary Hydraulic Pump -- Cutaway View
Figure 1



VIEW LOOKING FORWARD AND INBOARD AT LEFT WING ROOT AREA

VIEW A

Auxiliary Hydraulic Pump
Figure 2

(2) The electric motor is a 115/200-volt, 3-phase, 400-cps, continuous duty motor rated at 6.5 hp at 11,300 rpm. The motor rotor has an internally splined output shaft which fits on the externally splined input shaft of the pump. The other end of the rotor shaft drives a cooling fan which forces cooling air between the motor case and the outer shroud. A thermoswitch located in the motor case is provided to shut off the motor in case of an overheat condition. An override function of the control switch in the flight compartment is provided to override the thermoswitch for emergency operation.

(3) The centrifugal boost pump impeller is located on the drive shaft between the motor and the variable displacement pump. The impeller draws hydraulic fluid from the system and supplies it through an external tube to the inlet port of the variable displacement pump under pressure, thereby helping to prevent cavitation of the pump.

(4) The variable displacement hydraulic pump consists of the following major parts: a four piece housing, drive shaft with impeller, axial cylinder barrel containing 9 pistons, pivoting hanger with an inclined camface, hold down plate, pressure compensating valve, and bearings.

(5) When the electric motor is actuated, the drive shaft rotates the boost pump impeller and the cylinder and piston group. Each revolution of the cylinder causes one complete stroke of each piston. The pistons are held against the camface of the hanger by the hold down plate, providing positive piston return. The displacement of fluid from the pump discharge port is controlled by the compensator valve. The pump provides full flow of 3.9 gpm at system pressures up to approximately 2700 psi. At this point, the compensator valve reduces flow until at approximately 3000 psi, displacement of fluid is reduced to zero.

C. Auxiliary Hydraulic Pump Alternate Reservoir

(1) The auxiliary hydraulic pump alternate reservoir is installed on the shear web in the left wing root area, immediately aft of the auxiliary hydraulic pump. Access to the reservoir is through the left wing root access door. The alternate reservoir supplies hydraulic fluid to the auxiliary hydraulic pump in the event the fluid supply from the main hydraulic system reservoir is exhausted.

(2) The reservoir is cylindrical in shape and has a fluid capacity of approximately 1.9 US gallons (1.6 Imperial gallons or 7.3 liters). There are four ports on the reservoir: an outlet port to the auxiliary hydraulic pump selector valve located at the bottom, an inlet port from the auxiliary hydraulic pump bypass located near the top on the side, an inlet from the wing flap return line, and an outlet to the main hydraulic reservoir located at the top. A sight gage is installed near the top of the reservoir for visual indication of fluid level, and a mounting boss for the emergency hydraulic level indicating light switch is installed on the side of the reservoir.

(3) The reservoir is kept full during operation by routing fluid from the wing flap return line to the reservoir. Fluid in excess of the alternate reservoir capacity is then routed to the main hydraulic system reservoir capacity is then routed to the main hydraulic system reservoir. Hydraulic fluid from the auxiliary pump bypass is routed to the alternate reservoir and then to the main reservoir. Fluid is used from the alternate reservoir only when the auxiliary pump is operating and the auxiliary pump supply selector valve is in the alternate position. Fluid supply to the alternate reservoir is replenished whenever the wing flaps are operated.

D. Auxiliary Hydraulic Pump Supply Selector Valve (See Figure 3.)

(1) The auxiliary hydraulic pump supply valve is a 2-position valve that ports hydraulic fluid from the reservoir, through a common outlet, to the auxiliary pump. The selector valve is located on the shear web in the left wing root, near the auxiliary pump. The selector valve is accessible through the left wing root access door.

(2) The valve body has two inlet ports and one outlet port. The outlet port is centrally located on the aft side of the valve body. The two inlet ports are located on the outboard side of the valve body, 90 degrees from the outlet port. Two mounting flanges are located on the inboard side of the valve body. These flanges are an integral part of the valve body.

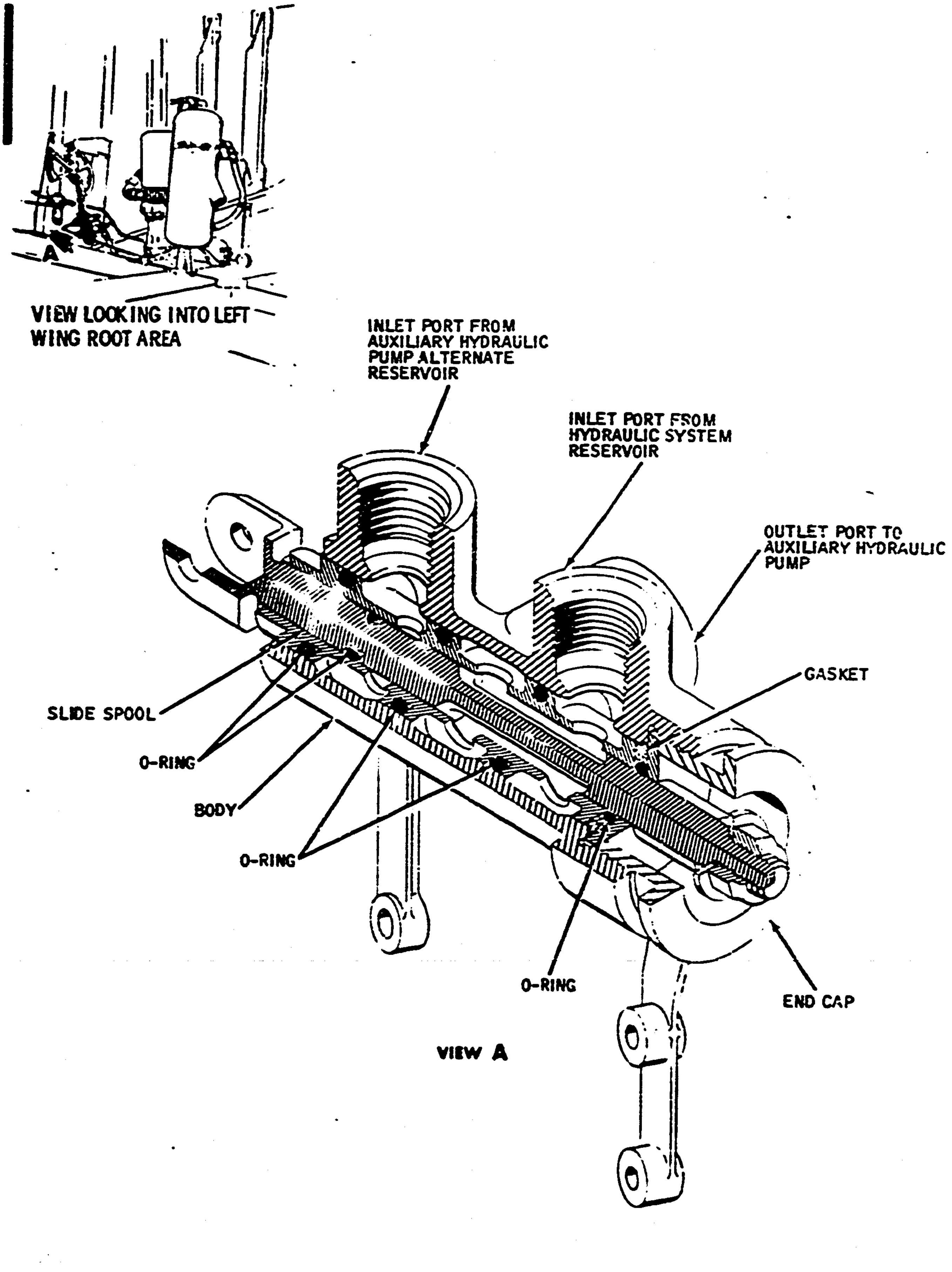
(3) During normal operation, fluid is taken from a low standpipe in the main hydraulic system reservoir and ported to the auxiliary pump. When the valve is in the alternate position, fluid is taken from the auxiliary hydraulic pump alternate reservoir and ported to the auxiliary pump. The valve is moved from the auxiliary position to the alternate position by placing the hydraulic system selector control lever, located on the system engineer's control pedestal, to the general system/main gear downlock and flaps position.

E. Auxiliary Hydraulic Pump Relief Valve (See Figure 4.)

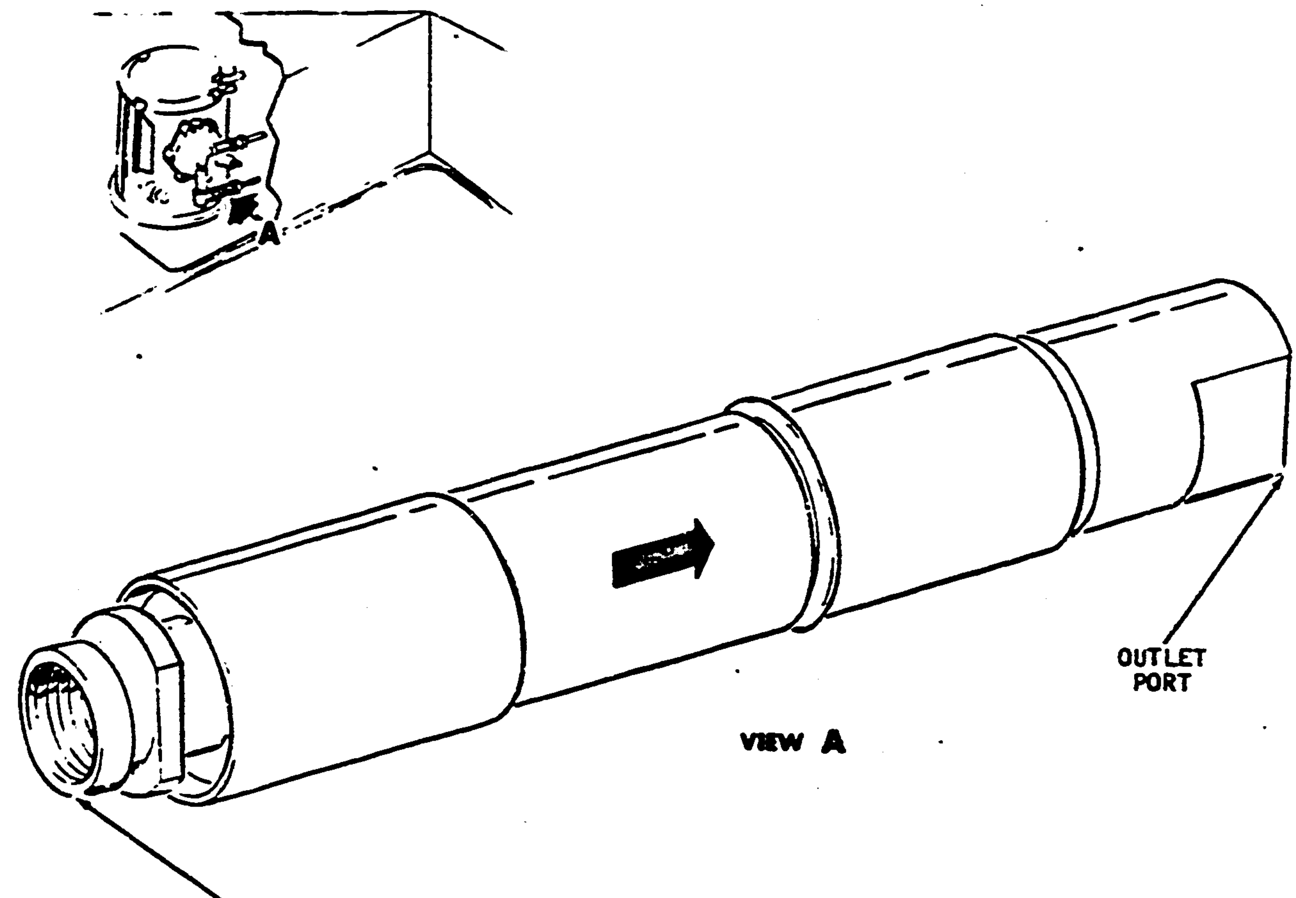
(1) The auxiliary hydraulic pump relief valve is a spring loaded poppet-type valve and serves to relieve excess fluid pressure that may build up in the auxiliary hydraulic system. The relief valve connects, through a reducer, to a tee in the A return port of the hydraulic system reservoir. The valve is accessible through the left wing root access door.

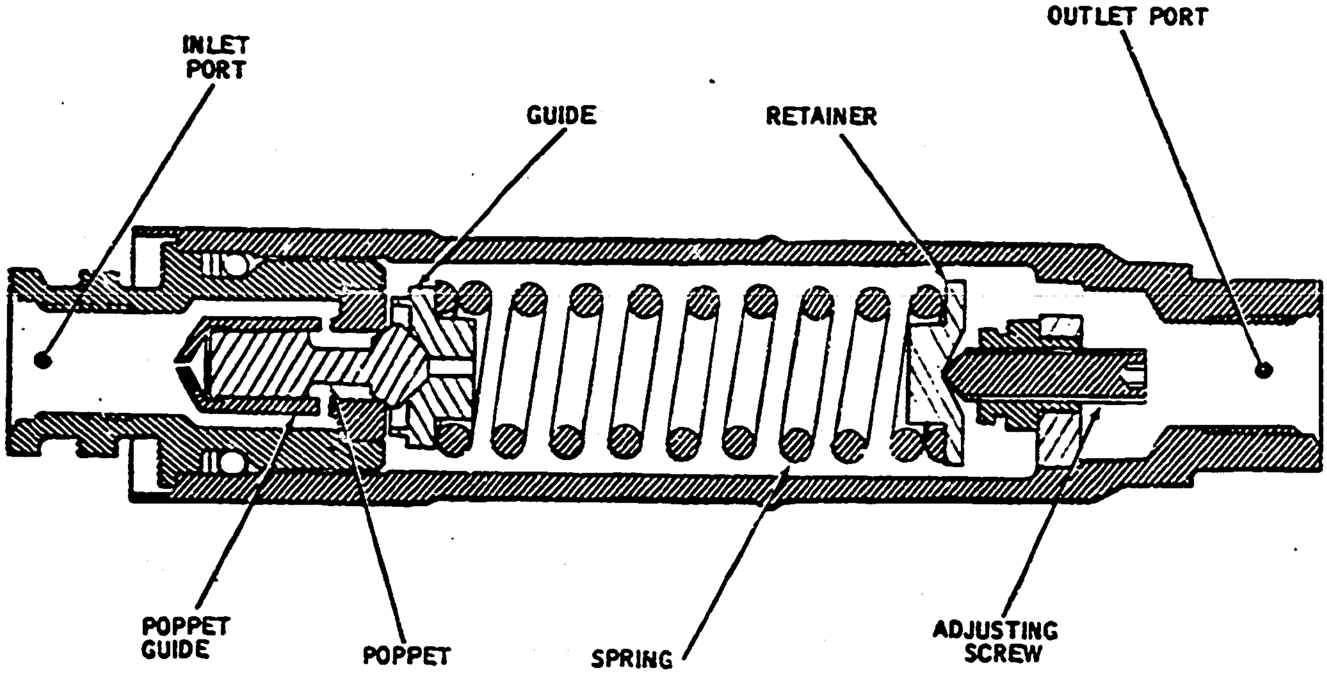
(2) Externally, the valve body is cylindrical, approximately 5 inches in length, and 1 inch in diameter. The outlet end of the valve is slightly larger than the inlet end.

(3) When pressure builds up, the poppet starts to relieve at approximately 3300 psi. If pressure continues to build up, the poppet continues to open until 3500 psi and a maximum flow of 3.5 gpm are reached. When pressure is relieved, the poppet reseats at 90 percent of the unseat pressure.



Auxiliary Hydraulic Pump Supply Selector Valve -- Cutaway View
Figure-3





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Auxiliary Hydraulic Pump Relief Valve -- Cutaway View
Figure 4

F. Auxiliary Hydraulic System Filter (See Figure 5.)

(1) A line-type, 10 micron filter assembly is installed in the piping of the auxiliary system to filter fluid from the pressure outlet port of the auxiliary pump to the system selector valve. The filter is located on the bulkhead near the forward inboard corner of the left main gear wheel well, slightly inboard and above the dual filter and relief valve. It is accessible through the left main gear inboard door.

(2) The inlet and outlet ports of the filter are internally threaded and are marked in and out. The filter bowl is cylindrical in shape, with wrench flats at the lower end, and is threaded into the assembly immediately below the ports. A hex-shaped magnetic plug is installed in the drain port. The filter element is stainless steel mesh, supported by a perforated cylindrical center core.

G. Auxiliary Hydraulic Pump Bypass Line Filter (See Figure 6.)

(1) Airplanes N8095U - N8099U, N8966U and subsequent are equipped with a disposable auxiliary hydraulic pump bypass line filter. The bypass line filter is supported by an elbow connection to the side port of the alternate reservoir with the pump bypass line connecting to the bottom of the filter.

H. Auxiliary Hydraulic System Check Valve

(1) The auxiliary hydraulic system check valve in a spring-loaded, poppet-type valve with a rated capacity of 3000 psi. This valve is installed in the line between the auxiliary hydraulic system filter and the system selector valve to prevent reverse flow of hydraulic fluid through the filter and the auxiliary pump when the engine-driven pumps or external pressure supply are used.

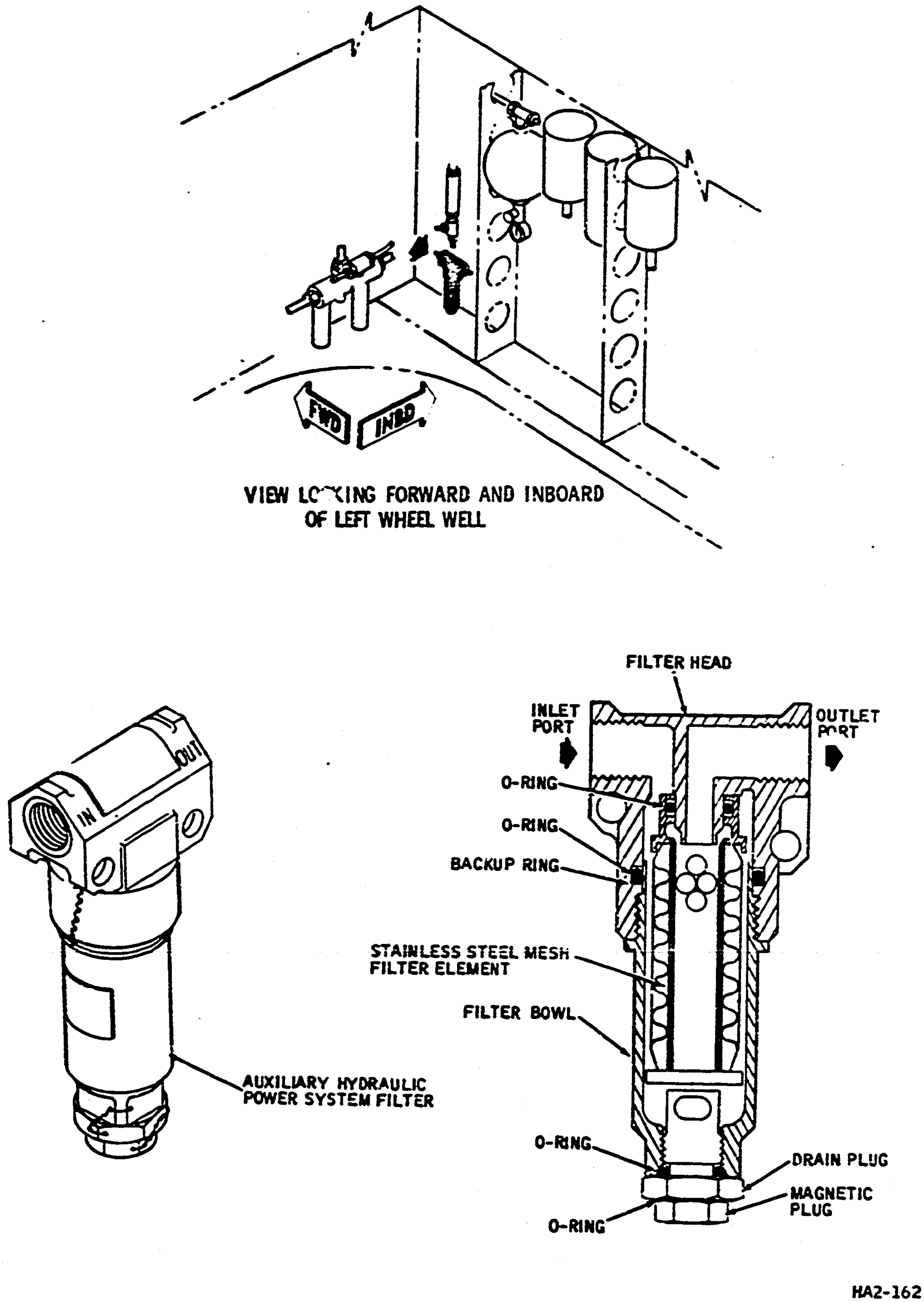
(2) The auxiliary hydraulic system check valve is located in the left wheel well, just above the dual filter and relief valve. The auxiliary hydraulic system check valve is accessible through the left wheel well.

(3) Externally and internally, this valve is similar to the engine-driven hydraulic pump check valve, except for size.

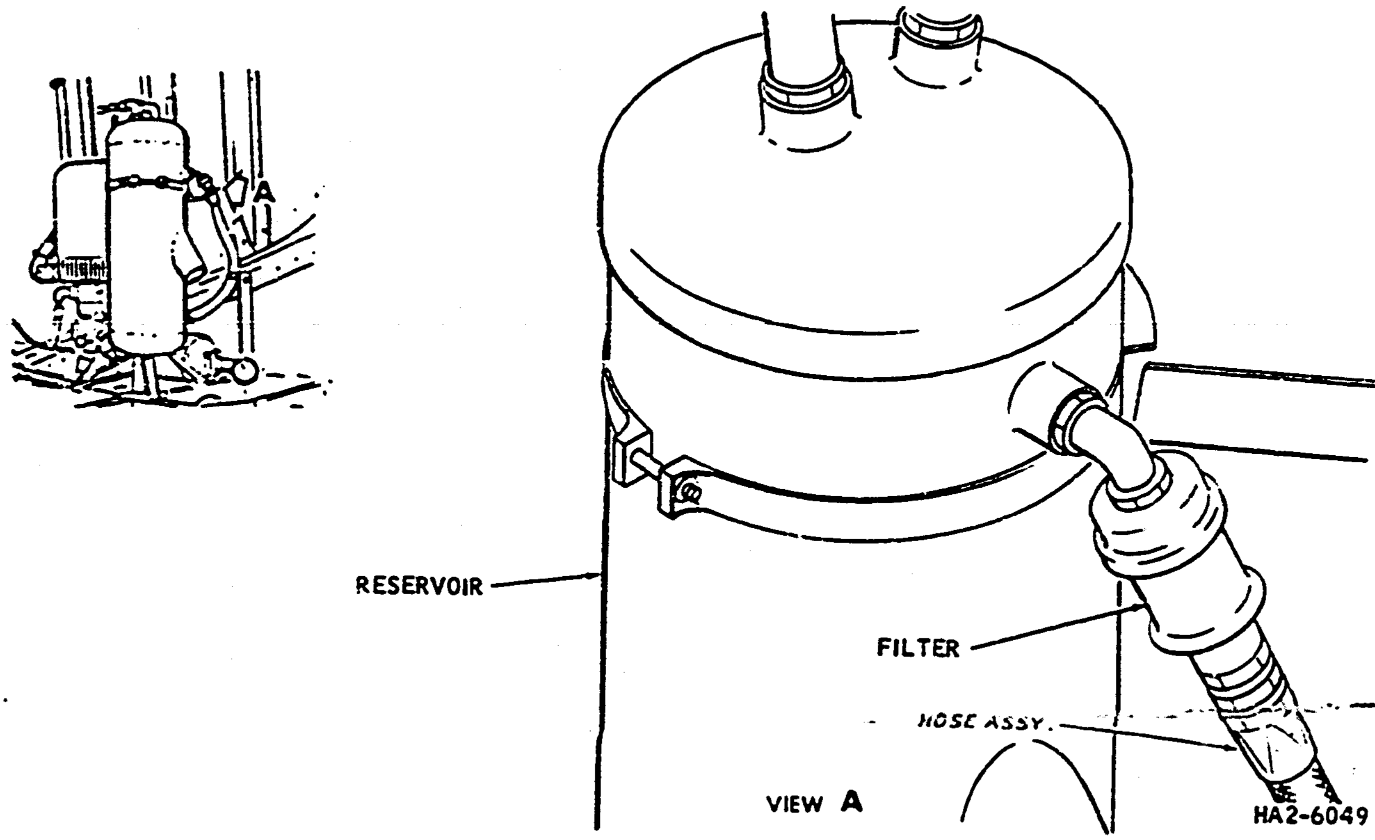
I. Auxiliary Hydraulic System Surge Damper Accumulator (See Figure 7.)

(1) The auxiliary hydraulic system surge damper accumulator consists of two spherical domes, separated by a diaphragm and held together by a ring nut. An air filler valve and gage are installed on the accumulator. The accumulator is installed in the auxiliary hydraulic pump pressure line just inboard and aft of the auxiliary pump, and is attached to the shear web by two clamp blocks. Access to the accumulator is through the left wing root access door.

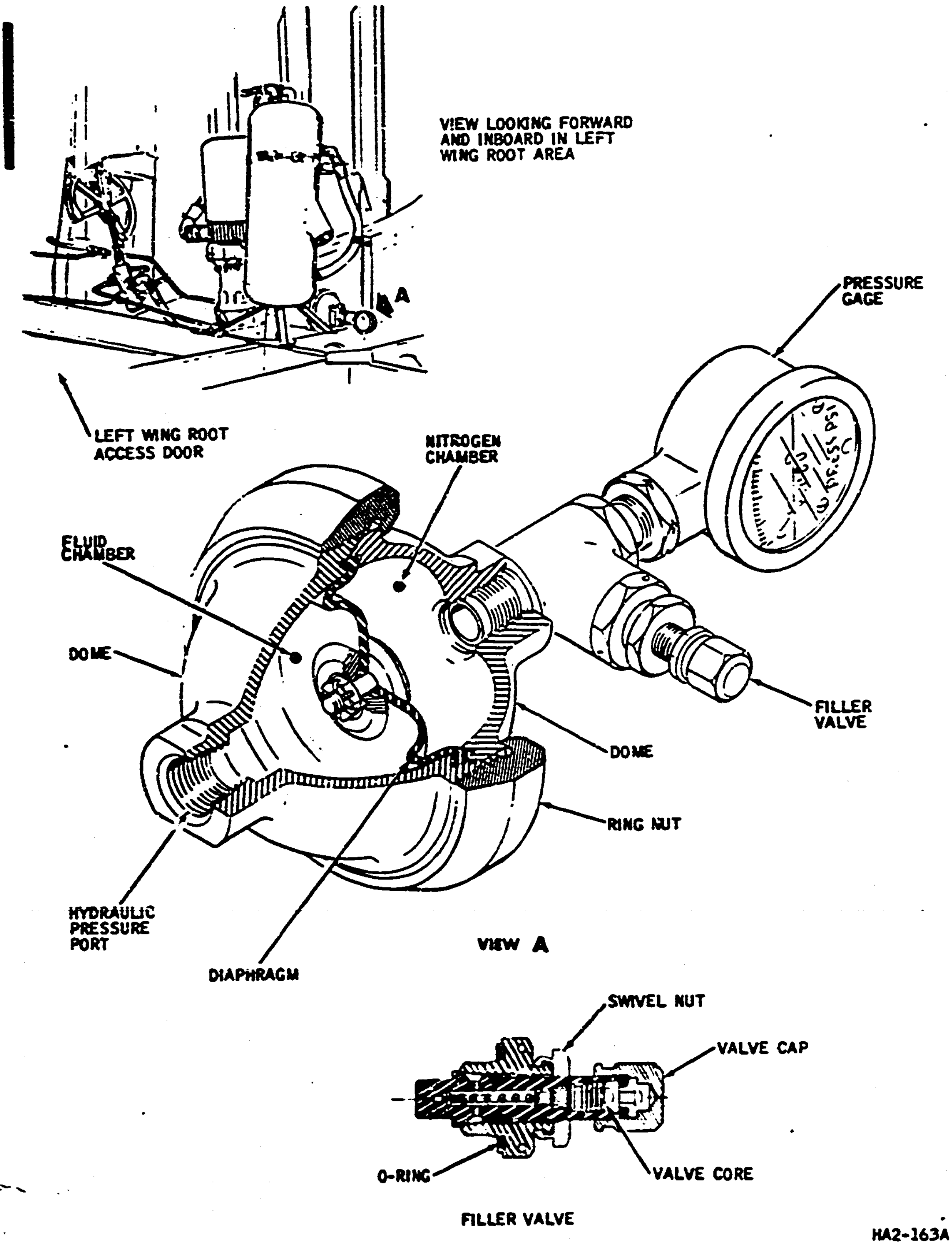
(2) The accumulator is initially charged to 1000 psi with dry nitrogen. As the auxiliary system pressure builds up, fluid is forced against the



Auxiliary Hydraulic System Filter -- Cutaway View
Figure 5



Auxiliary Hydraulic Pump Bypass Line Filter
(Airplanes N8095U-N8099U and N8966U and Subsequent)
Figure 6



Auxiliary Hydraulic Power System Surge Damper
Accumulator -- Cutaway View
Figure 7

diaphragm in the accumulator, further compressing the trapped nitrogen in the air side of the accumulator to full system pressure (2600 to 3000 psi is indicated on the accumulator pressure gage). The air in the accumulator absorbs the initial shock of the auxiliary pump output and permits the system pressure to rise gradually. The accumulator also serves to cushion the piping and system components against high impact loads.

J. Auxiliary Hydraulic Pump Control

(1) The auxiliary hydraulic pump control system consists of auxiliary hydraulic pump control switch, an auxiliary hydraulic pump control relay, and auxiliary hydraulic pump power relay, an electric motor, and an auxiliary pump on indicating light.

(2) The auxiliary hydraulic pump control switch(es), located in the flight compartment, are 3-position switches. They are spring-loaded to the center position and have to momentary positions placarded start (hold only in emergency) and stop.

(3) The electric motor for the auxiliary hydraulic pump is an ac, 3-phase motor. A thermostatic switch is included in the circuit to protect the motor from overheating.

(4) The auxiliary hydraulic pump motor is supplied with power from the cabin bus 4. This permits pump operation from an external power source or from the airplane electrical system.

(5) The auxiliary pump on indicating light is a blue press-to-test light, located adjacent to the auxiliary hydraulic pump control switch. The light is equipped with a dimming feature.

(6) When the auxiliary hydraulic pump control switch is momentarily moved to the start position, the circuitry is completed between the auxiliary hydraulic pump control relay and cabin bus 4. The ground is through the stop contact of the switch and the thermostatic switch of the motor. Once the relay is energized, it remains energized through its own holding contacts. Through a closed contact of the pump control relay, power is supplied from cabin bus 4 to energize the hydraulic pump power relay. Through the closed contacts of the pump power relay, a power circuit is completed from the feeder leads of cabin bus 4 to the auxiliary hydraulic pump motor. The blue indicating light, located on the overhead switch panel, receives power through one of the closed contacts of the pump power relay. Therefore, the light is on whenever the pump power relay is energized.

(7) The auxiliary hydraulic pump motor is safeguarded against overheating by the thermostatic switch. Under normal conditions, this switch is in the ground leg of the control relay. When an overheat condition occurs, the thermostatic switch opens the control relay circuit to limit the motor case to 450°F (252°C). This action deenergizes the control relay, which in turn deenergizes the power relay. In an emergency situation,

the thermostatic switch can be overridden by holding the auxiliary hydraulic pump control switch in the start (hold only in emergency) position.

(8) When the auxiliary hydraulic pump control switch is placed in the momentary stop position, the ground for the control relay is broken, deenergizing the power relay and removing power from the pump motor and the indicating light.

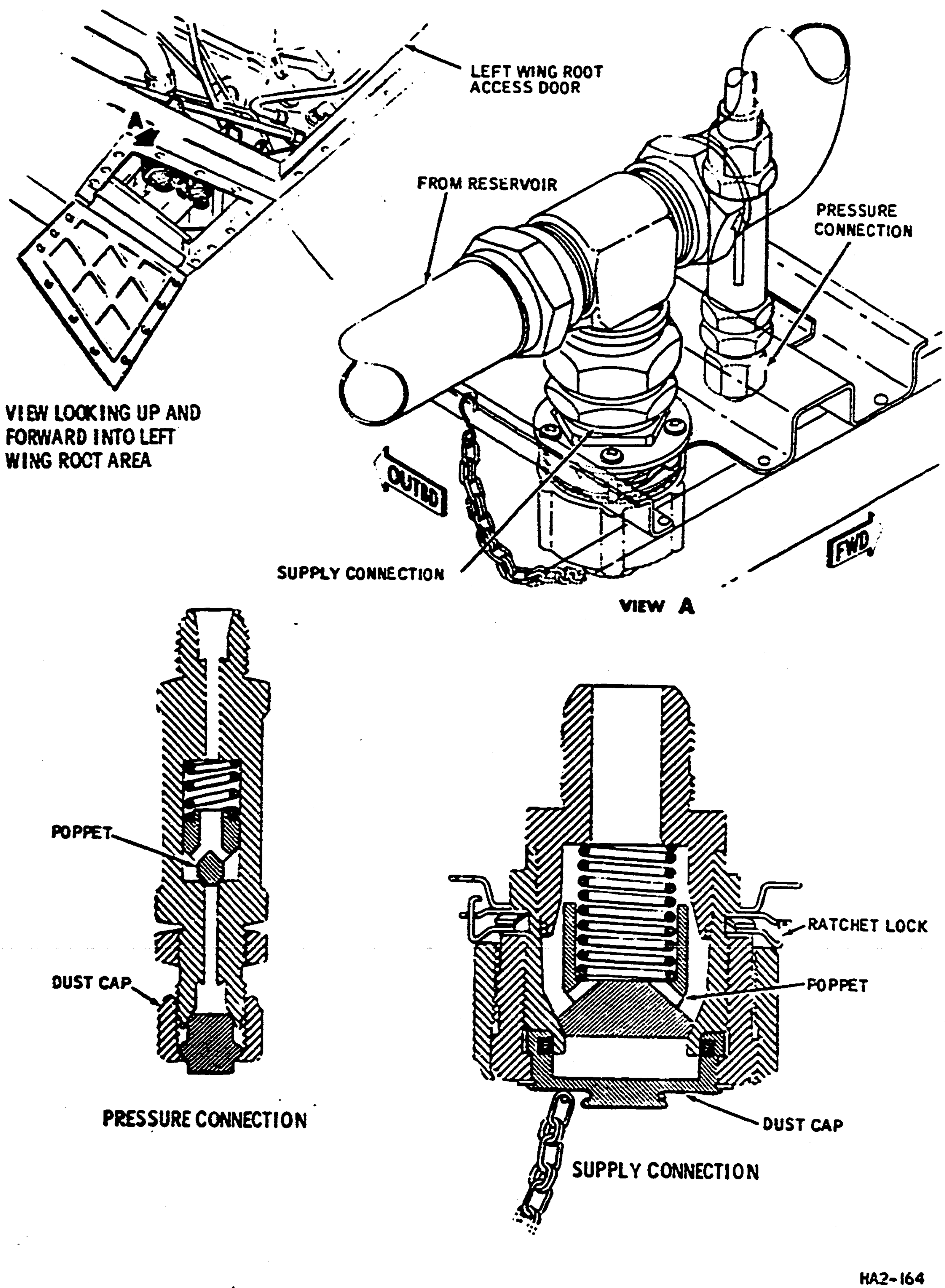
K. Ground Service Pressure and Supply Connectors (See Figure 8.)

(1) The ground service pressure and supply connectors are external fittings to which a service unit can be connected for operating the hydraulic power system when there is no power on the airplane. The connectors are located on a panel covered by an access door on the lower skin of the left wing root, aft of the rear spar.

(2) The ground service pressure connector is made up of a check valve with a flared, bulkhead-type fitting on the inlet end and a standard tube fitting on the outlet end which connects the left engine-driven pump pressure line. The inlet fitting is covered with a dust cap when not in use.

(3) The internal description of the connector is the same as that of the engine-driven hydraulic pump check valve (see 29-10-0, Description and Operation). The connector operates as a shutoff valve when the ground unit is not connected. When a ground hydraulic power source is connected to the pressure connector and pressure is applied, the poppet unseats and supplies pressure fluid to the hydraulic power system.

(4) The supply connector is made up of a T-fitting and a self-sealing coupling half. The tee is female-threaded to accept the bulkhead-type fitting on the upper end of the coupling. The cross arms of the tee tie into the right engine-driven pump supply line with flared-type fittings. The tee is threaded onto the coupling half and is secured with a locknut. The coupling consists of a coupling body, male-threaded to accept the coupling half only from the ground source. The mounting flange has a recess to accept the hex portion of the coupling body, and has notches to retain the lockspring. A dustcap consisting of a union nut assembly, a dust plug, and a securing chain is installed on the lower end of the coupling when not in use.



Ground Power Connectors -- Cutaway View
Figure 8

AUXILIARY - TROUBLESHOOTING

1. Troubleshooting

	Possible Causes	Isolation Procedure	Correction
A.	NO AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE		
(1)	Open circuit (blown limiter fuse) in one phase of electric power to motor.	Check limiter fuses to all three phases. Find cause of blown fuse.	Correct cause of blown fuse. Replace limiter fuse.
(2)	Electrical system inoperative.	Check electrical system.	Repair as necessary.
(3)	Hydraulic system selector in general system/main gear downlock and flaps position.	Check position of control lever.	Move lever to general system (normal) or bypass/ general system position.
(4)	Hydraulic reservoir fluid level too low.	Check reservoir fluid level.	Fill reservoir to proper level.
(5)	Defective auxiliary pump selector valve.	Check function of valve.	Replace valve.
(6)	Auxiliary pump relief valve bypassing fluid.	Check function of valve.	Replace valve.
(7)	Defective auxiliary hydraulic pump.	Check function of pump.	Replace pump and motor.
(8)	Open hydraulic line between auxiliary pump and selector valve.	Check lines for security of attachment and leaks.	Repair as necessary.

	Possible Causes	Isolation Procedure	Correction
A.	**NO AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE (Continued)**		
(9)	Damaged auxiliary pump electric motor.	Check motor operation.	Replace motor and pump.
(10)	Defective thermostatic switch in auxiliary pump motor.	Check switch by over-riding it.	Replace auxiliary pump and motor.
B.	**LOW AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE**		
(1)	Clogged auxiliary pump filter.	Check condition of filter element.	Replace filter element.
(2)	Defective auxiliary pump relief valve.	Check function of relief valve.	Replace relief valve.
(3)	Hydraulic leaks in auxiliary hydraulic system.	Check for broken lines or loose fittings.	Replace lines or tighten fittings.
(4)	Defecitve auxiliary hydraulic pump.	Check function of pump.	Replace auxiliary pump and motor.
(5)	Internal leakage of hydraulic system selector valve.	Place control lever in bypass/general system position and check auxiliary hydraulic pump pressure in flight compartment for 2800 to 3000 psi.	Note pressure and move control lever to next position.
		Place control lever in general system (normal) position and check auxiliary hydraulic pump pressure in flight compartment.	Pressure should be the same as that indicated in previous step. If pressure differs between steps, replace selector valve.

	Possible Causes	Isolation Procedure	Correction
B.	**LOW AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE (Continued)**		
(6)	Defective auxiliary pump electric motor.	Check motor operation.	Replace auxiliary pump and motor.
(7)	Open circuit (blown limiter fuse) in one phase of electric power to motor.	Check fuses to all three phases. Find cause of blown fuse.	Correct cause of blown fuse, and replace fuse.
C.	**AUXILIARY HYDRAULIC PUMP DOES NOT OPERATE IN ANY SWITCH POSITION**		
(1)	No electric power.	Check circuit breaker position.	Close circuit breaker.
(2)	Blown limiter fuses.	Check fuses for continuity. Find cause of blown fuse.	Correct cause of blown fuse and replace fuse.
(3)	Faulty power relay.	Check relay.	Replace relay.
(4)	Faulty control switch.	Check function of control switch.	Replace switch.
(5)	Open circuit in wiring.	Check continuity of control circuit wiring.	Repair or replace wiring.
(6)	Wiring in pump electrical connector or circuit in incorrect phase sequence.	Use phase sequence lights to check phase rotation in pump power circuit.	Make correct connections and check phase rotation.
(7)	Faulty control relay.	Check relay.	Replace relay.
(8)	Defective pump motor.	Completion of steps (1) through (7) with no fault discovered.	Replace pump and motor.

	Possible Causes	Isolation Procedure	Correction
D.	AUXILIARY HYDRAULIC PUMP ONLY OPERATES WHEN HELD IN START POSITION		
(1)	Faulty control relay.	Check relay.	Replace relay.
(2)	Faulty control switch.	Check continuity of control switch.	Replace switch.
(3)	Open wiring in control circuit.	Check continuity of control circuit wiring.	Repair or replace wiring.
(4)	Faulty thermoswitch in motor.	Check continuity of thermoswitch.	Replace pump and motor.
E.	AUXILIARY HYDRAULIC PUMP DOES NOT STOP WHEN SWITCH PLACED IN STOP POSITION		
(1)	Faulty control switch.	Check continuity of control switch.	Replace switch.
(2)	Faulty control relay.	Chec[illegible]ay.	Replace relay.
(3)	Faulty control circuit wiring.	Check continuity of wiring.	Repair or replace wiring.
F.	INDICATING LIGHT INOPERATIVE		
(1)	Burned out lamp.	Check lamp.	Replace lamp.
(2)	Faulty press-to-test switch.	Check switch.	Replace light.
(3)	Faulty wiring to press-to-test switch.	Check continuity of wiring to switch.	Repair or replace wiring.
(4)	Faulty indicating light wiring.	Check continuity of indicating light wiring.	Repair or replace wiring.

AUXILIARY - TROUBLESHOOTING

1. Troubleshooting

	Possible Causes	Isolation Procedure	Correction
A.	**NO AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE**		
(1)	Open circuit (blown limiter fuse) in one phase of electric power to motor.	Check limiter fuses to all three phases. Find cause of blown fuse.	Correct cause of blown fuse. Replace limiter fuse.
(2)	Electrical system inoperative.	Check electrical system.	Repair as necessary.
(3)	Hydraulic system selector in general system/flaps only position.	Check position of control lever.	Move lever to general system (normal) or bypass/ general system position.
(4)	Hydraulic reservoir fluid level too low.	Check reservoir fluid level.	Fill reservoir to proper level.
(5)	Defective auxiliary pump selector valve.	Check function of valve.	Replace valve.
(6)	Auxiliary pump relief valve bypassing fluid.	Check function of valve.	Replace valve.
(7)	Defective auxiliary hydraulic pump.	Check function of pump.	Replace pump and motor.
(8)	Open hydraulic line between auxiliary pump and selector valve.	Check lines for security of attachment and leaks.	Repair as necessary.

	Possible Causes	Isolation Procedure	Correction
A.	**NO AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE (Continued)**		
(9)	Damaged auxiliary pump electric motor.	Check motor operation.	Replace motor and pump.
(10)	Defective thermostatic switch in auxiliary pump motor.	Check switch by overriding it.	Replace auxiliary pump and motor.
B.	**LOW AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE**		
(1)	Clogged auxiliary pump filter.	Check condition of filter element.	Replace filter element.
(2)	Defective auxiliary pump relief valve.	Check function of relief valve.	Replace relief valve.
(3)	Hydraulic leaks in auxiliary hydraulic system.	Check for broken lines or loose fittings.	Replace lines or tighten fittings.
(4)	Defective auxiliary hydraulic pump.	Check function of pump.	Replace auxiliary pump and motor.
(5)	Internal leakage of hydraulic system selector valve.	Place control lever in bypass/general system position and check auxiliary hydraulic pump pressure in flight compartment for 2800 to 3000 psi.	Note pressure and move control lever to next position.
		Place control lever in general system (normal) position and check auxiliary hydraulic pump pressure in flight compartment.	Pressure should be the same as that indicated in previous step. If pressure differs between steps, replace selector valve.

Possible Causes	Isolation Procedure	Correction
B. LOW AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE (Continued)		
(6) Defective auxiliary pump electric motor.	Check motor operation.	Replace auxiliary pump and motor.
(7) Open circuit (blown limiter fuse) in one phase of electric power to motor.	Check fuses to all three phases. Find cause of blown fuse.	Correct cause of blown fuse, and replace fuse.
C. AUXILIARY HYDRAULIC PUMP DOES NOT OPERATE IN ANY SWITCH POSITION		
(1) No electric power.	Check circuit breaker position.	Close circuit breaker.
(2) Blown limiter fuses.	Check fuses for continuity. Find cause of blown fuse.	Correct cause of blown fuse and replace fuse.
(3) Faulty power relay.	Check relay.	Replace relay.
(4) Faulty control switch.	Check function of control switch.	Replace switch.
(5) Open circuit in wiring	Check continuity of control circuit wiring.	Repair or replace wiring.
(6) Wiring in pump electrical connector or circuit in incorrect phase sequence.	Use phase sequence lights to check phase rotation in pump power circuit.	Make correct connections and check phase rotation.
(7) Faulty control relay.	Check relay.	Replace relay.
(8) Defective pump motor.	Completion of steps (1) through (7) with no fault discovered.	Replace pump and motor.

Possible Causes	Isolation Procedure	Correction
D. AUXILIARY HYDRAULIC PUMP ONLY OPERATES WHEN HELD IN START POSITION		
(1) Faulty control relay.	Check relay.	Replace relay.
(2) Faulty control switch.	Check continuity of control switch.	Replace switch.
(3) Open wiring in control circuit.	Check continuity of control circuit wiring.	Repair or replace wiring.
(4) Faulty thermoswitch in motor.	Check continuity of thermoswitch.	Replace pump and motor.
E. AUXILIARY HYDRAULIC PUMP DOES NOT STOP WHEN SWITCH PLACED IN STOP POSITION		
(1) Faulty control switch.	Check continuity of control switch.	Replace switch.
(2) Faulty control relay.	Check relay.	Replace relay.
(3) Faulty control circuit wiring.	Check continuity of wiring.	Repair or replace wiring.
F. INDICATING LIGHT INOPERATIVE		
(1) Burned out lamp.	Check lamp.	Replace lamp.
(2) Faulty press-to-test switch.	Check switch.	Replace light.
(3) Faulty wiring to press-to-test switch.	Check continuity of wiring to switch.	Repair or replace wiring.
(4) Faulty indicating light wiring.	Check continuity of indicating light wiring.	Repair or replace wiring.

AUXILIARY - TROUBLE SHOOTING

1. Trouble Shooting

Possible Causes	Isolation Procedure	Correction
A. NO AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE		
(1) Open circuit (blown limiter fuse) in one phase of electric power to motor.	Check limiter fuses to all three phases. Find cause of blown fuse.	Correct cause of blown fuse. Replace limiter fuse.
(2) Electrical system inoperative.	Check electrical system.	Repair as necessary.
(3) Hydraulic system selector in general system/flaps only position.	Check position of control lever.	Move lever to general system (normal) or bypass/ general system position.
(4) Hydraulic reservoir fluid level too low.	Check reservoir fluid level.	Fill reservoir to proper level.
(5) Defective auxiliary pump selector valve.	Check function of valve.	Replace valve.
(6) Auxiliary pump relief valve bypassing fluid.	Check function of valve.	Replace valve.
(7) Defective auxiliary hydraulic pump.	Check function of pump.	Replace pump and motor.
(3) Open hydraulic line between auxiliary pump and selector valve.	Check lines for security of attachment and leaks.	Repair as necessary.

Possible Causes	Isolation Procedure	Correction
A. NO AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE (Continued)		
(9) Damaged auxiliary pump electric motor.	Check motor operation.	Replace motor and pump.
(10) Defective thermostatic switch in auxiliary pump motor.	Check switch by overriding it.	Replace auxiliary pump and motor.
B. LOW AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE		
(1) Clogged auxiliary pump filter.	Check condition of filter element.	Replace filter element.
(2) Defective auxiliary pump relief valve.	Check function of relief valve.	Replace relief valve.
(3) Hydraulic leaks in auxiliary hydraulic system.	Check for broken lines or loose fittings.	Replace lines or tighten fittings.
(4) Defective auxiliary hydraulic pump.	Check function of pump.	Replace auxiliary pump and motor.
(5) Internal leakage of hydraulic system selector valve.	Place control lever in bypass/general system position and check auxiliary hydraulic pump pressure in flight compartment for 2800 to 3000 psi.	Note pressure and move control lever to next position.
	Place control lever in general system (normal) position and check auxiliary hydraulic pump pressure in flight compartment.	Pressure should be the same as that indicated in previous step. If pressure differs between steps, replace selector valve.

Possible Causes	Isolation Procedure	Correction
B. LOW AUXILIARY PUMP HYDRAULIC SYSTEM PRESSURE (Continued)		
(6) Defective auxiliary pump electric motor.	Check motor operation.	Replace auxiliary pump and motor.
(7) Open circuit (blown limiter fuse) in one phase of electric power to motor.	Check fuses to all three phases. Find cause of blown fuse.	Correct cause of blown fuse, and replace fuse.
C. AUXILIARY HYDRAULIC PUMP DOES NOT OPERATE IN ANY SWITCH POSITION		
(1) No electric power.	Check circuit breaker position.	Close circuit breaker.
(2) Blown limiter fuses.	Check fuses for continuity. Find cause of blown fuse.	Correct cause of blown fuse and replace fuse.
(3) Faulty power relay.	Check relay.	Replace relay.
(4) Faulty control switch.	Check function of control switch.	Replace switch.
(5) Open circuit in wiring.	Check continuity of control circuit wiring.	Repair or replace wiring.
(6) Wiring in pump electrical connector or circuit in incorrect phase sequence.	Use phase sequence lights to check phase rotation in pump power circuit.	Make correct connections and check phase rotation.
(7) Faulty control relay.	Check relay.	Replace relay.
(8) Defective pump motor.	Completion of steps (1) through (7) with no fault discovered.	Replace pump and motor.

Possible Causes	Isolation Procedure	Correction
D. AUXILIARY HYDRAULIC PUMP ONLY OPERATES WHEN HELD IN START POSITION		
(1) Faulty control relay.	Check relay.	Replace relay.
(2) Faulty control switch.	Check continuity of control switch.	Replace switch.
(3) Open wiring in control circuit.	Check continuity of control circuit wiring.	Repair or replace wiring.
(4) Faulty thermoswitch in motor.	Check continuity of thermoswitch.	Replace pump and motor.
(5) Faulty cargo door control switch	Check continuity of cargo door control switch.	Readjust or replace switch as required.
E. AUXILIARY HYDRAULIC PUMP DOES NOT STOP WHEN SWITCH PLACED IN STOP POSITION		
(1) Faulty control switch.	Check continuity of control switch.	Replace switch.
(2) Faulty control relay.	Check relay.	Replace relay.
(3) Faulty control circuit wiring.	Check continuity of wiring.	Repair or replace wiring.
F. INDICATING LIGHT INOPERATIVE		
(1) Burned out lamp.	Check lamp.	Replace lamp.
(2) Faulty press-to-test switch.	Check switch.	Replace light.
(3) Faulty wiring to press-tc-test switch.	Check continuity of wiring to switch.	Repair or replace wiring.

Possible Causes	Isolation Procedure	Correction
F. INDICATING LIGHT INOPERATIVE (Continued)		
(4) Faulty indicating light wiring.	Check continuity of indicating light wiring.	Repair or replace wiring.
G. AUXILIARY HYDRAULIC PUMP DOES NOT OPERATE WHEN CARGO DOOR CONTROL HANDLE IS MOVED TO OPEN OR CLOSE POSITIONS		
(1) No electric power.	Check circuit breaker position.	Close circuit breaker.
(2) Blown limiter fuses.	Check fuses for continuity and isolate cause of blown fuses.	Correct cause of blown fuses and replace fuses.
(3) Auxiliary hydraulic pump motor thermostatic switch open or inoperative.	Check pump for overheated condition; check continuity of thermostatic switch.	Allow pump to cool or replace pump as required.
(4) Faulty cargo door control switch.	Actuate flight compartment auxiliary hydraulic pump control switch (or switches). Check continuity of cargo door control switch.	Readjust or replace switches as required.
(5) Faulty cargo door control switch wiring.	Check continuity of cargo door control switch wiring	Repair or replace wiring.

NOTE: For further cargo door operating procedures, trouble shooting procedures, and related precautions, see Chapter 52.

AUXILIARY HYDRAULIC PUMP SUPPLY SELECTOR VALVE - MAINTENANCE PRACTICES

1. General

   A. The auxiliary hydraulic pump supply selector valve is located in the left wing root on the sheer web near the auxiliary hydraulic pump.

   B. Access to the supply selector valve is through the left wing root access door.

2. Removal/Installation Auxiliary Hydraulic Pump Supply Selector Valve

   A. Remove Supply Selector Valve

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir and auxiliary hydraulic pump alternate reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect auxiliary pump supply hose from outlet port of auxiliary hydraulic pump supply selector valve.

      (6) Disconnect supply lines from inlet ports of valve.

      (7) Disconnect pushrod from slide spool clevis fitting.

      (8) Remove selector valve.

      (9) Remove fittings from selector valve and retain for use in new unit. Discard O-rings.

   B. Install Supply Selector Valve

      (1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

      (2) Using new O-rings, install fittings in selector valve ports.

      (3) Install selector valve.

(4) Connect supply lines to inlet ports of selector valve.

(5) Connect auxiliary pump supply hose to outlet port of selector valve.

(6) Place hydraulic system selector control lever in bypass/general system position.

(7) Spoke of auxiliary pump selector valve sector (7) (see 29-10-0, Maintenance Practices, Figure 501, View A-A) should be 3/16 inch past edge of leg (18) of its support bracket.

(8) Extend spool of auxiliary pump selector valve (16) 5/32 inch beyond valve sleeve.

(9) Adjust pushrod to proper length and connect to slide valve clevis fitting.

(10) Tighten jamnut on pushrod.

(11) Fill hydraulic reservoir (see instruction placard on reservoir).

(12) Fill alternate hydraulic reservoir (see 29-20-8, Maintenance Practices).

(13) Close auxiliary hydraulic pump control circuit breaker.

3. <u>Inspection/Check Auxiliary Hydraulic Pump Supply Selector Valve</u>

A. Check Supply Selector Valve

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize auxiliary hydraulic system (see 29-00, Maintenance Practices).

<u>WARNING</u>: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Check that hydraulic system selector control lever is in general system/main gear downlock and flaps position.

(4) Cycle wing flaps by placing wing flap control handle in up and then in down position.

(5) Depressurize auxiliary hydraulic system (see 29-00, Maintenance Practices).

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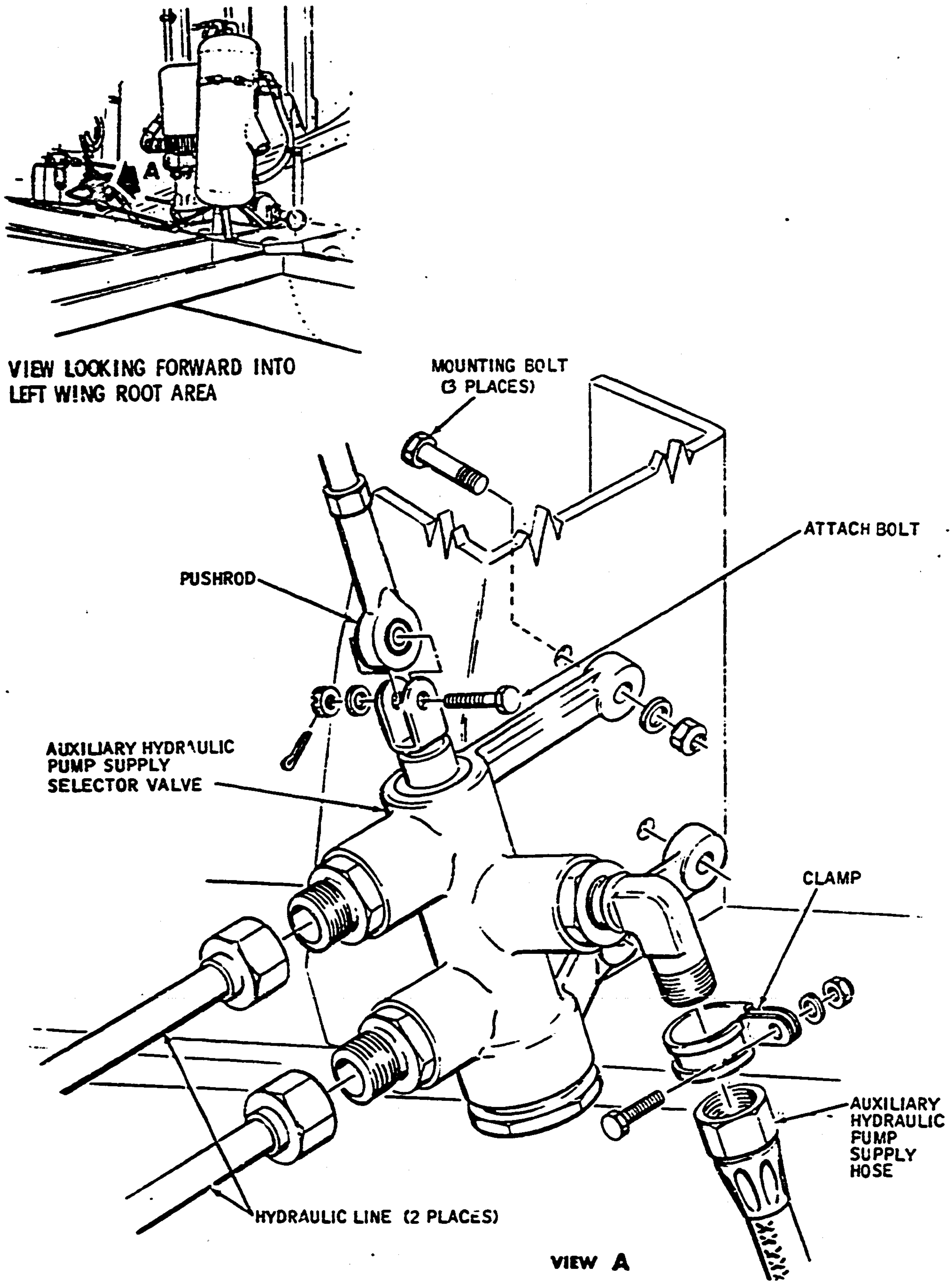

Auxiliary Hydraulic Pump Supply Selector
Valve -- Installation
Figure 201

HA2-165A

(6) Check auxiliary hydraulic pump supply selector valve, lines, and fittings for leaks, general condition, and security of mounting.

(7) Check selector valve pushrod jamnut for security of attachment and safety lock.

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AUXILIARY HYDRAULIC PUMP SUPPLY SELECTOR VALVE - MAINTENANCE PRACTICES

1. General

   A. The auxiliary hydraulic pump supply selector valve is located in the left wing root on the shear web near the auxiliary hydraulic pump.

   B. Access to the supply selector valve is through the left wing root access door.

2. Removal/Installation Auxiliary Hydraulic Pump Supply Selector Valve

   A. Remove Supply Selector Valve

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin 4 bus section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir and auxiliary hydraulic pump alternate reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect auxiliary pump supply hose from outlet port of auxiliary hydraulic pump supply selector valve.

      (6) Disconnect supply lines from inlet ports of valve.

      (7) Disconnect pushrod from slide spool clevis fitting.

      (8) Remove selector valve.

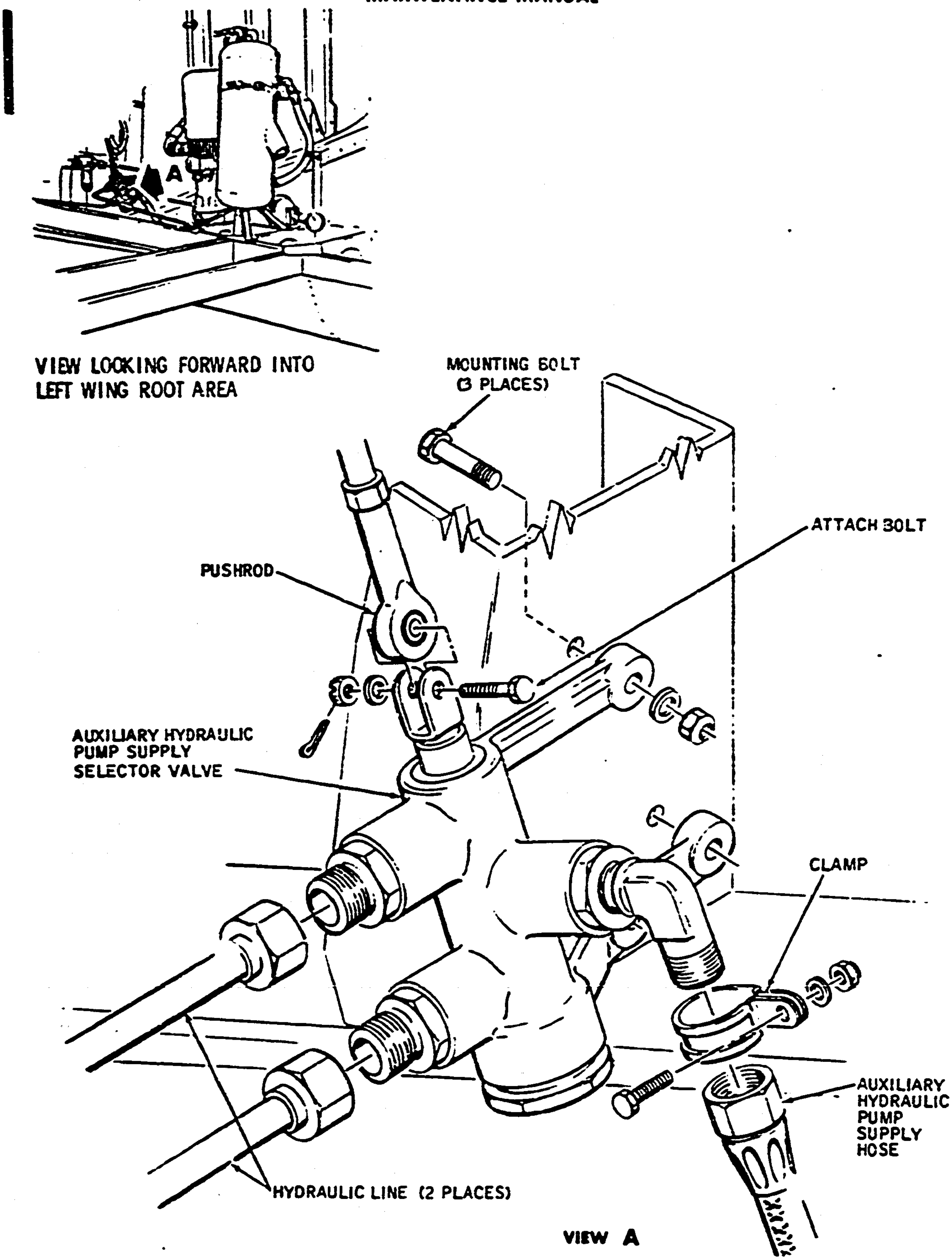
      (9) Remove fittings from selector valve and retain for use in new unit. Discard O-rings.

   B. Install Supply Selector Valve

      (1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

      (2) Using new O-rings, install fittings in selector valve ports.

      (3) Install selector valve.



HA2-165A

Auxiliary Hydraulic Pump Supply Selector
Valve -- Installation
Figure 201

(4) Connect supply lines to inlet ports of selector valve.

(5) Connect auxiliary pump supply hose to outlet port of selector valve.

(6) Place hydraulic system selector control lever in bypass/general system position.

(7) Spoke of auxiliary pump selector valve sector (7) (see 29-10-0, Maintenance Practices, Figure 501, View A-A) should be 3/16 inch past edge of leg (18) of its support bracket.

(8) Extend spool of auxiliary pump selector valve (16) 5/32 inch beyond valve sleeve.

(9) Adjust pushrod to proper length and connect to slide valve clevis fitting.

(10) Tighten jamnut on pushrod.

(11) Fill hydraulic reservoir (see instruction placard on reservoir).

(12) Fill alternate hydraulic reservoir (see 29-20-8, Maintenance Practices).

(13) Close auxiliary hydraulic pump control circuit breaker.

3. Inspection/Check Auxiliary Hydraulic Pump Supply Selector Valve

A. Check Supply Selector Valve

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize auxiliary hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Check that hydraulic system selector control lever is in general system/flaps only position.

(4) Cycle wing flaps by placing wing flap control handle in up and then in down position.

(5) Depressurize auxiliary hydraulic system (see 29-00, Maintenance Practices).

(6) Check auxiliary hydraulic pump supply selector valve, lines, and fittings for leaks, general condition, and security of mounting.

(7) Check selector valve pushrod jamnut for security of attachment and safety lock.

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AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

   A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

   B. Access to the auxiliary hydraulic pump is through the left wing root access door.

2. Tools and Equipment Required

   A. General purpose oil (MIL-L-7870) is used for lubrication of the auxiliary hydraulic pump gear box.

3. Servicing Auxiliary Hydraulic Pump

   A. Lubricate Auxiliary Hydraulic Pump Gear Box.

      (1) Remove fill and oil level plugs.

      (2) Add general purpose oil (MIL-L-7870) as required up to oil level plug.

      (3) Install oil level plug.

      (4) Add 45 cc oil above level plug oil level.

      (5) Install fill plug.

      (6) Safety fill plug to oil level plug with lockwire.

4. Removal/Installation Auxiliary Hydraulic Pump

   A. Remove Auxiliary Hydraulic Pump

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect electrical connect from auxiliary hydraulic pump motor.

      (6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect bypass hose from bypass port.

(9) Disconnect drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports, retain for use on new pump. Discard O-rings.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Using new O-rings, install fittings in pump ports.

(3) Install pump on mounting bracket.

(4) Connect electrical connect to auxiliary hydraulic pump motor.

(5) Connect supply hose to suction port of pump.

(6) Connect pressure hose to pressure port of pump.

(7) Connect bypass line to bypass port.

(8) Connect drain line to drain port.

(9) Fill hydraulic reservoir as described on instruction placard on reservoir.

(10) Close auxiliary hydraulic pump control circuit breaker.

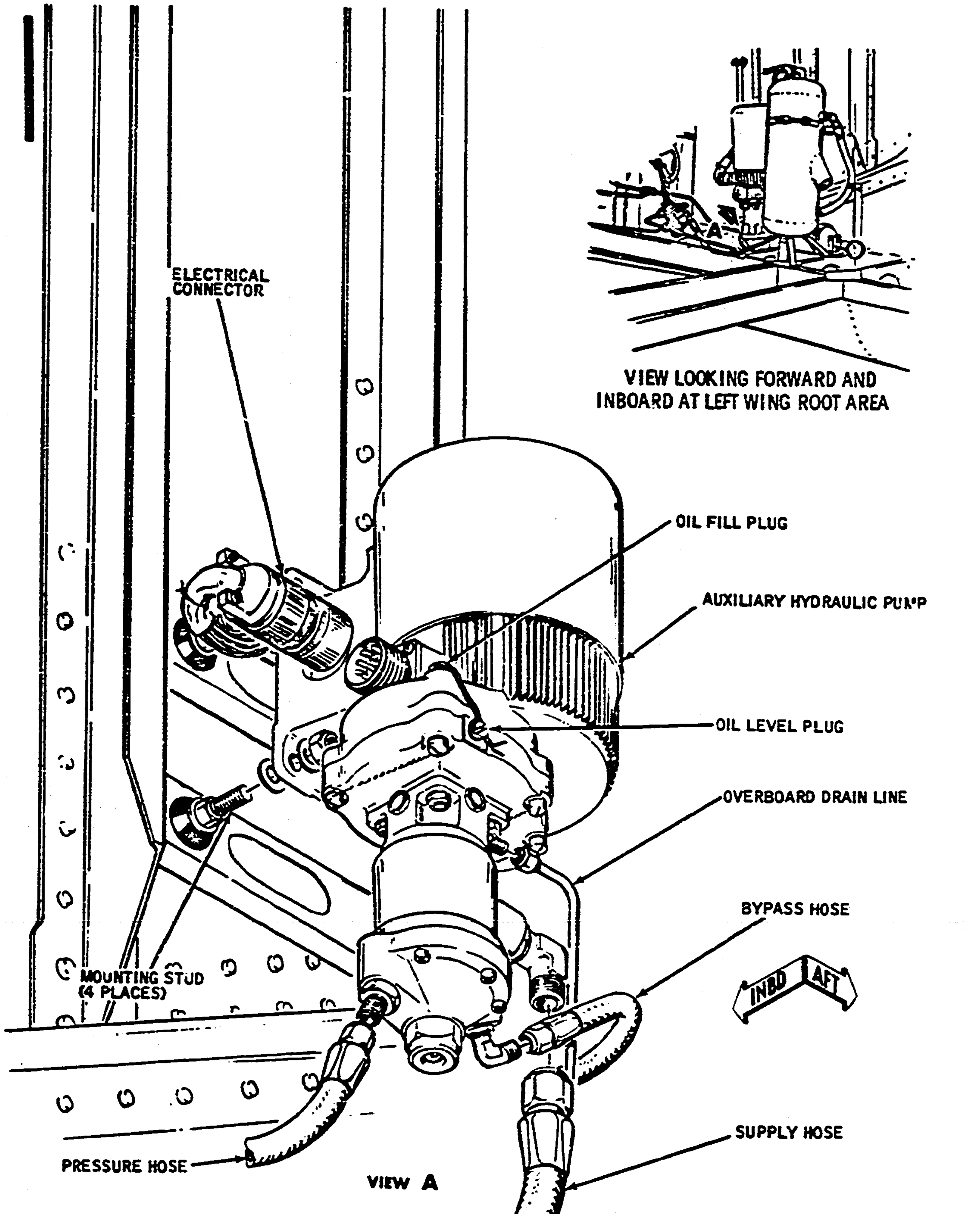
5. Inspection/Check Auxiliary Hydraulic Pump

A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Place rudder and aileron hydraulic power control levers in off position.

(3) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).



Auxiliary Hydraulic Pump -- Installation
Figure 201

(4) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency position.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(5) Check hydraulic system pressure indicator in flight compartment for 2800- to 3000-psi indication.

NOTE: With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(6) Place auxiliary hydraulic pump switch momentarily in stop position.

(7) Check auxiliary hydraulic pump for security of attachment and leaks.

(8) Check hydraulic lines for security, clearance, and leaks.

(9) Check electrical connector on pump motor for security of attachment and condition of wiring.

AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

B. Access to the auxiliary hydraulic pump is through the left wing root access door.

2. Tools and Equipment Required

A. Clean Skydrol hydraulic fluid is used for filling the auxiliary hydraulic pump case.

3. Servicing Auxiliary Hydraulic Pump

A. Prior to installing pump, fill pump case with clean Skydrol hydraulic fluid through case drain port.

B. Prior to operation after installation, bleed air from pump as follows:

(1) Place hydraulic system control lever in general system (normal) position.

(2) Pressurize hydraulic system reservoir by manual method (see 29-00, Maintenance Practices).

(3) Open B-nut at case drain port sufficiently to allow all air to escape from pump; tighten B-nut.

4. Removal/Installation Auxiliary Hydraulic Pump

A. Remove Auxiliary Hydraulic Pump

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connect from auxiliary hydraulic pump motor.

(6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect case drain hose from case drain port.

(9) Disconnect seal cavity drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports; retain for use on new pump. Discard O-rings.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Using new O-rings, install fittings in pump ports.

(3) Fill pump case with clean Skydrol (see paragraph 3, Servicing).

(4) Install pump on mounting bracket.

(5) Connect electrical connect to auxiliary hydraulic pump motor.

(6) Connect supply hose to suction port of pump.

(7) Connect pressure hose to pressure port of pump.

(8) Connect case drain line to case drain port.

(9) Connect seal cavity drain line to drain port.

(10) Fill hydraulic reservoir as described on instruction placard on reservoir.

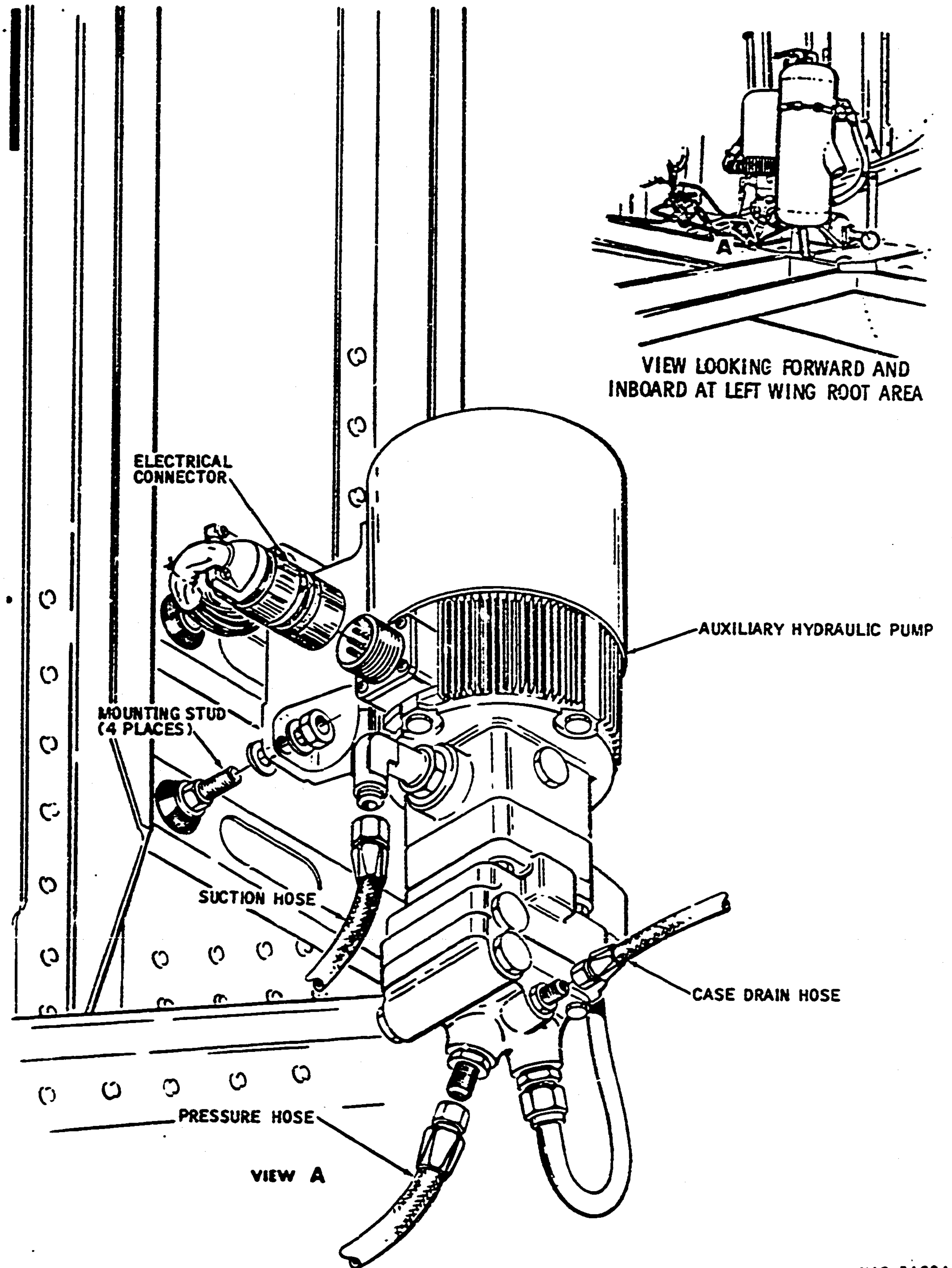
(11) Bleed air from pump case (see paragraph 3, Servicing).

(12) Close auxiliary hydraulic pump control circuit breaker.

5. <u>Inspection/Check Auxiliary Hydraulic Pump</u>

A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.



Auxiliary Hydraulic Pump -- Installation
Figure 201

(2) Place rudder and aileron hydraulic power levers in off position.

(3) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(4) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency) position.

<u>WARNING</u>: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

<u>CAUTION</u>: BEFORE OPERATING THE PUMP MAKE SURE THAT ALL AIR HAS BEEN BLED FROM THE PUMP AND PUMP IS COMPLETELY FULL OF SKYDROL HYDRAULIC FLUID.

<u>CAUTION</u>: DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(5) Check hydraulic system pressure indicator in flight compartment for 2600- to 3000-psi indicator.

<u>NOTE</u>: With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(6) Place auxiliary hydraulic pump switch momentarily in stop position.

(7) Check auxiliary hydraulic pump for security of attachment and leaks.

(8) Check hydraulic lines for security, clearance, and leaks.

(9) Check electrical connector on pump motor for security of attachment and condition of wiring.

AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

B. Access to the auxiliary hydraulic pump is through the left wing root access door.

2. Tools and Equipment Required

A. General purpose oil (MIL-L-7870) is used for lubrication of the auxiliary hydraulic pump gear box.

3. Servicing Auxiliary Hydraulic Pump

A. Lubricate Auxiliary Hydraulic Pump Gear Box

(1) Remove fill and oil level plugs.

(2) Add general purpose oil (MIL-L-7870) as required up to oil level plug.

(3) Install oil level plug.

(4) Add 45 cc oil above level plug oil level.

(5) Install fill plug.

(6) Safety fill plug to oil level plug with lockwire.

4. Removal/Installation Auxiliary Hydraulic Pump

A. Remove Auxiliary Hydraulic Pump

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connect from auxiliary hydraulic pump motor.

(6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect bypass hose from bypass port.

(9) Disconnect drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports; retain for use on new pump. Discard O-rings.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker, located on cabin bus 4 of EPC circuit breaker panel is open.

(2) Using new O-rings, install fittings in pump ports.

(3) Install pump on mounting bracket.

(4) Connect electrical connect to auxiliary hydraulic pump motor.

(5) Connect supply hose to suction port of pump.

(6) Connect pressure hose to pressure port of pump.

(7) Connect bypass line to bypass port.

(8) Connect drain line to drain port.

(9) Fill hydraulic reservoir as described on instruction placard on reservoir.

(10) Close auxiliary hydraulic pump control circuit breaker.

5. <u>Inspection/Check Auxiliary Hydraulic Pump</u>

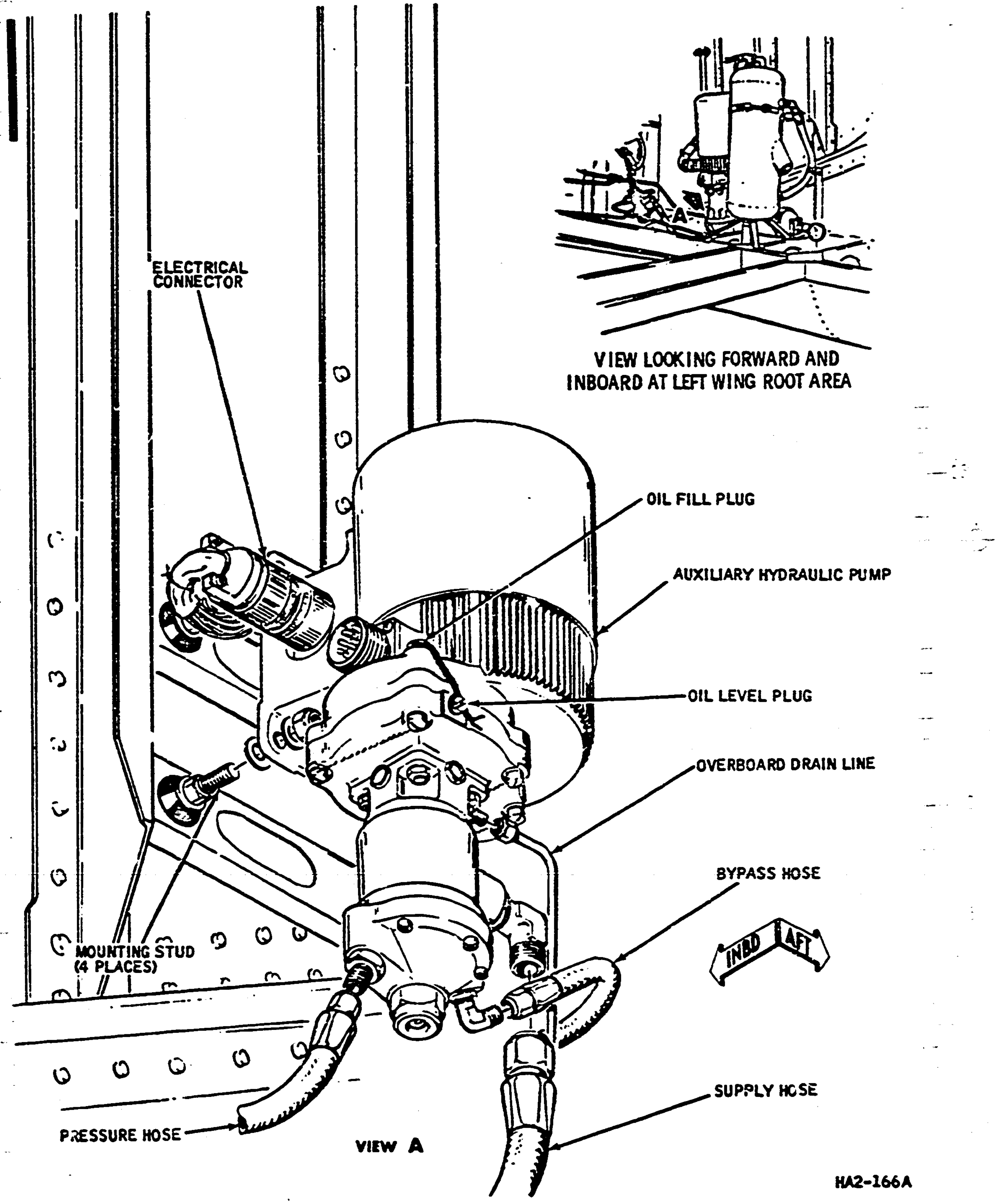
A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Place rudder and aileron hydraulic power control levers in off position.

(3) Open air compressor control and water separation circuit breaker located on dc bus 4 section of EPC circuit breaker panel.

(4) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).



Auxiliary Hydraulic Pump -- Installation
Figure 201

(5) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency) position.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(6) Check hydraulic system pressure indicator in flight compartment for 2800- to 3000-psi indication.

NOTE: With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(7) Place auxiliary hydraulic pump switch momentarily in stop position.

(8) Check auxiliary hydraulic pump for security of attachment and leaks.

(9) Check hydraulic lines for security, clearance, and leaks.

(10) Check electrical connector on pump motor for security of attachment and condition of wiring.

(11) Close air compressor control and water separation circuit breaker.

AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

B. Access to the auxiliary hydraulic pump is through the left wing root access door.

2. Tools and Equipment Required

A. Clean Skydrol hydraulic fluid is used for filling the auxiliary hydraulic pump case.

3. Servicing Auxiliary Hydraulic Pump

A. Prior to installing pump, fill pump case with clean Skydrol hydraulic fluid through case drain port.

B. Prior to operation after installation, bleed air from pump as follows:

(1) Place hydraulic system control lever in general system (normal) position.

(2) Pressurize hydraulic system reservoir by manual method (see 29-00, Maintenances Practices).

(3) Open B-nut at case drain port sufficiently to allow all air to escape from pump; tighten B-nut.

4. Removal/Installation Auxiliary Hydraulic Pump

A. Remove Auxiliary Hydraulic Pump

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connect from auxiliary hydraulic pump motor.

(6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect case drain hose from case drain port.

(9) Disconnect seal cavity drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports; retain for use on new pump. Discard O-rings.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Using new O-rings, install fittings in pump ports.

(3) Fill pump case with clean Skydrol (see paragraph 3, Servicing).

(4) Install pump on mounting bracket.

(5) Connect electrical connect to auxiliary hydraulic pump motor.

(6) Connect supply hose to suction port of pump.

(7) Connect pressure hose to pressure port of pump.

(8) Connect case drain line to case drain port.

(9) Connect seal cavity drain line to drain port.

(10) Fill hydraulic reservoir as described on instruction placard on reservoir.

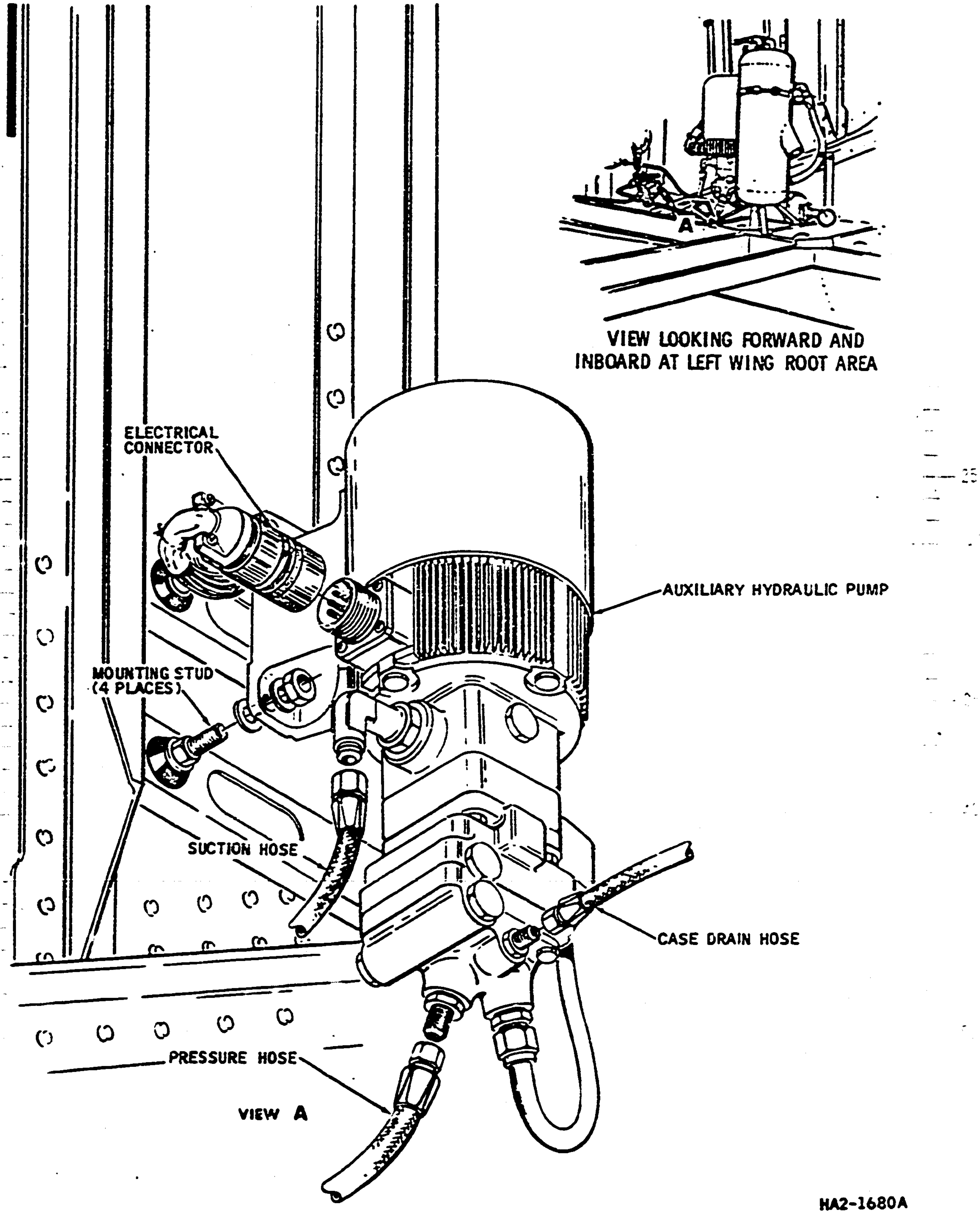
(11) Bleed air from pump case (see paragraph 3, Servicing).

(12) Close auxiliary hydraulic pump control circuit breaker.

5. <u>Inspection/Check Auxiliary Hydraulic Pump</u>

A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.



Auxiliary Hydraulic Pump -- Installation
Figure 201

(2) Place rudder and aileron hydraulic power control levers in off position.

(3) Open air compressor control and water separation circuit breaker located on dc bus 4 section of circuit breaker panel.

(4) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(5) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency) position.

<u>WARNING:</u> BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

<u>CAUTION:</u> BEFORE OPERATING THE PUMP MAKE SURE THAT ALL AIR HAS BEEN BLED FROM THE PUMP AND PUMP IS COMPLETELY FULL OF SKYDROL HYDRAULIC FLUID.

<u>CAUTION:</u> DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(6) Check hydraulic system pressure indicator in flight compartment for 2600- to 3000-psi indicator.

<u>NOTE:</u> With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(7) Place auxiliary hydraulic pump switch momentarily in stop position.

(8) Check auxiliary hydraulic pump for security of attachment and leaks.

(9) Check hydraulic lines for security, clearance, and leaks.

(10) Check electrical connector on pump motor for security of attachment and condition of wiring.

(11) Close air compressor control and water separation circuit breaker.

AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

B. Access to the auxiliary hydraulic pump is through the left wing root access door.

2. Tools and Equipment Required

A. General purpose oil (MIL-L-7870) is used for lubrication of the auxiliary hydraulic pump gear box.

3. Servicing Auxiliary Hydraulic Pump (Airplanes N8762-N8778)

A. Lubricate Auxiliary Hydraulic Pump Gear Box

(1) Remove fill and oil level plugs.

(2) Add general purpose oil (MIL-L-7870) as required up to oil level plug.

(3) Install oil level plug.

(4) Add 45 cc oil above level plug oil level.

(5) Install fill plug.

(6) Safety fill plug to oil level plug with lockwire.

4. Servicing Auxiliary Hydraulic Pump (Airplanes N8755-N8760)

A. Prior to installing pump, fill pump case with clean Skydrol hydraulic fluid through case drain port.

B. Prior to operation after installation, bleed air from pump as follows:

(1) Place hydraulic system control lever in general system (normal) position.

(2) Pressurize hydraulic system reservoir by manual method (see 29-00, Maintenance Practices).

(3) Open B-nut at case drain port sufficiently to allow all air to escape from pump; tighten B-nut.

5. Removal/Installation Auxiliary Hydraulic Pump

A. Remove Auxiliary Hydraulic Pump

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connector from auxiliary hydraulic pump motor.

(6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect bypass hose from bypass port.

(9) Disconnect drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports, retain for use on new pump. Discard O-rings.

NOTE: In the event the auxiliary hydraulic pump is operated without fluid or has failed, the pump and the following associated parts must be replaced prior to further operation.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Using new O-rings, install fittings in pump ports.

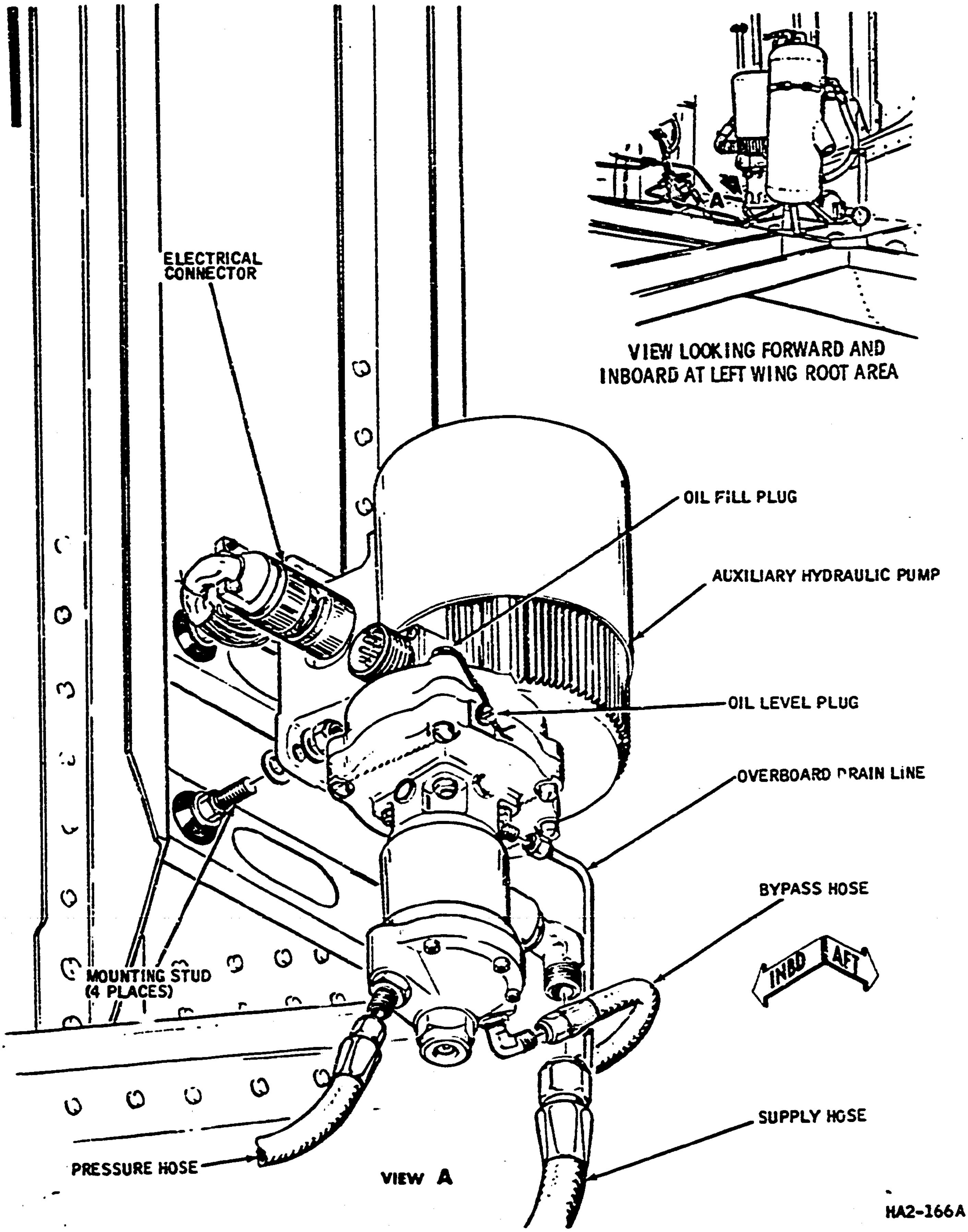
(3) Install pump on mounting bracket.

(4) Connect electrical connector to auxiliary hydraulic pump motor.

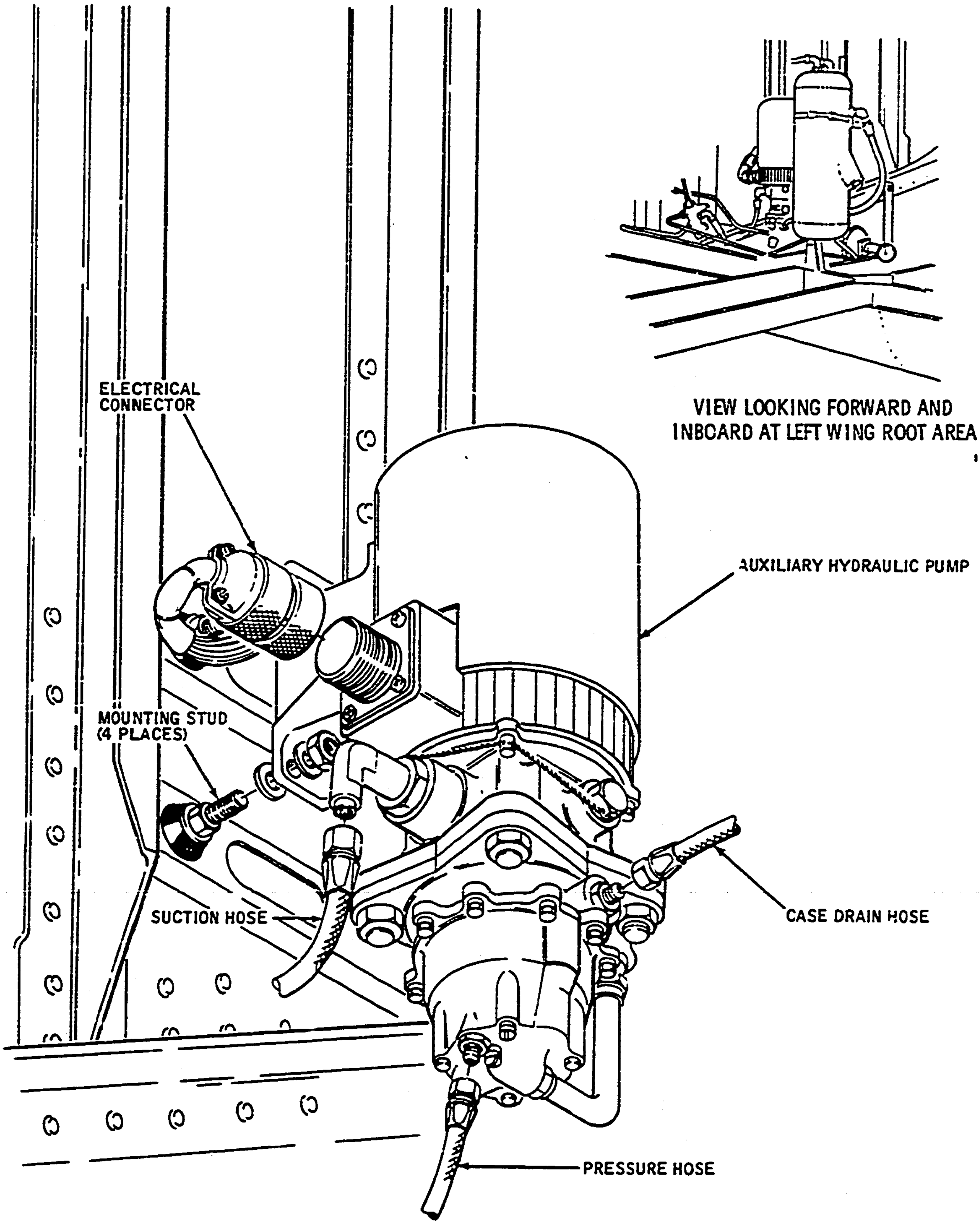
(5) Connect supply hose to suction port of pump.

(6) Connect pressure hose to pressure port of pump.

(7) Connect bypass line to bypass port.



Auxiliary Hydraulic Pump -- Installation
(Airplanes N8762-N8778)
Figure 201 (Sheet 1)



Auxiliary Hydraulic Pump -- Installation
(A_rplanes N8755-N8760)
Figure 201 (Sheet 2)

(8) Connect drain line to drain port.

(9) Fill hydraulic reservoir as described on instruction placard on reservoir.

(10) Close auxiliary hydraulic pump control circuit breaker.

6. Inspection/Check Auxiliary Hydraulic Pump

A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Place rudder and aileron hydraulic power control levers in off position.

(3) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(4) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency position).

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(5) Check hydraulic system pressure indicator in flight compartment for 2800- to 3000-psi indication.

NOTE: With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(6) Place auxiliary hydraulic pump switch momentarily in stop position.

(7) Check auxiliary hydraulic pump for security of attachment and leaks.

(8) Check hydraulic lines for security, clearance, and leaks.

(9) Check electrical connector on pump motor for security of attachment and condition of wiring.

AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

B. Access to the auxiliary hydraulic pump is through the left wing root access door.

2. Tools and Equipment Required

A. Clean Skydrol hydraulic fluid is used for filling the auxiliary hydraulic pump case.

3. Servicing Auxiliary Hydraulic Pump

A. Prior to installing pump, fill pump case with clean Skydrol hydraulic fluid through case drain port.

B. Prior to operation after installation, bleed air from pump as follows:

(1) Place hydraulic system control lever in general system (normal) position.

(2) Pressurize hydraulic system reservoir by manual method (see 29-00, Maintenance Practices).

(3) Open B-nut at case drain port sufficiently to allow all air to escape from pump; tighten B-nut.

4. Removal/Installation Auxiliary Hydraulic Pump

A. Remove Auxiliary Hydraulic Pump

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connector from auxiliary hydraulic pump motor.

(6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect case drain hose from case drain port.

(9) Disconnect seal cavity drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports; retain for use on new pump. Discard O-rings.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Using new O-rings, install fittings in pump ports.

(3) Fill pump case with clean Skydrol (see Paragraph 3, Servicing).

(4) Install pump on mounting bracket.

(5) Connect electrical connector to auxiliary hydraulic pump motor.

(6) Connect supply hose to suction port of pump.

(7) Connect pressure hose to pressure port of pump.

(8) Connect case drain line to case drain port.

(9) Connect seal cavity drain line to drain port.

(10) Fill hydraulic reservoir as described on instruction placard on reservoir.

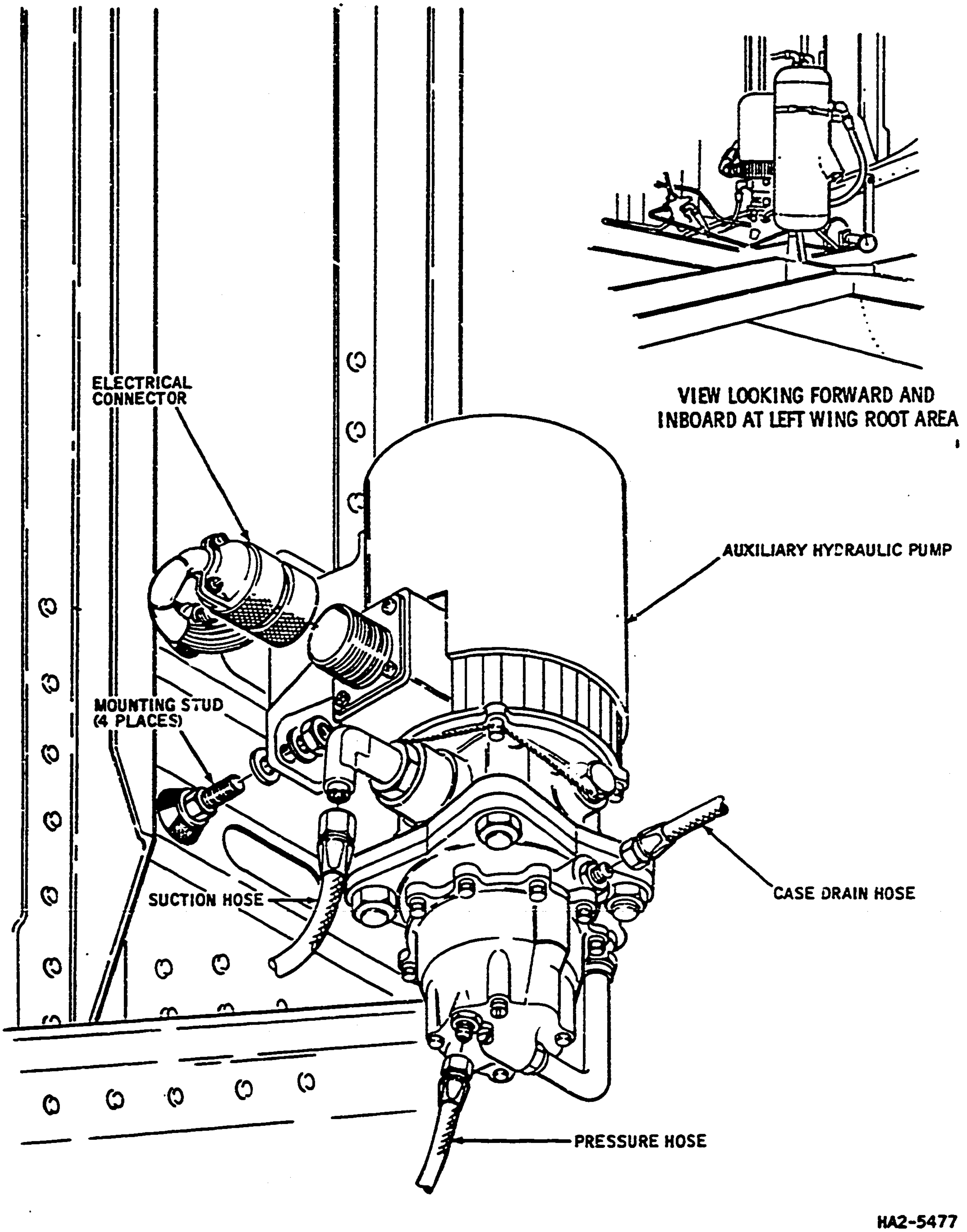
(11) Bleed air from pump case (see Paragraph 3, Servicing).

(12) Close auxiliary hydraulic pump control circuit breaker.

5. Inspection/Check Auxiliary Hydraulic Pump

A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.



Auxiliary Hydraulic Pump -- Installation
Figure 201

(2) Place rudder and aileron hydraulic power levers in off position.

(3) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(4) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency) position.

<u>WARNING:</u> BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

<u>CAUTION:</u> BEFORE OPERATING THE PUMP MAKE SURE THAT ALL AIR HAS BEEN BLED FROM THE PUMP AND PUMP IS COMPLETELY FULL OF SKYDROL HYDRAULIC FLUID.

<u>CAUTION:</u> DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(5) Check hydraulic system pressure indicator in flight compartment for 2600- to 3000-psi indicator.

<u>NOTE:</u> With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(6) Place auxiliary hydraulic pump switch momentarily in stop position.

(7) Check auxiliary hydraulic pump for security of attachment and leaks.

(8) Check hydraulic lines for security, clearance, and leaks.

(9) Check electrical connector on pump motor for security of attachment and condition of wiring.

AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

B. Access to the auxiliary hydraulic pump is through the left wing root acess door.

2. Tools and Equipment Required

A. Clean Skydrol hydraulic fluid is used for filling the auxiliary hydraulic pump case.

3. Servicing Auxiliary Hydraulic Pump

A. Prior to installing pump, fill pump case with clean Skydrol hydraulic fluid through case drain port.

B. Prior to operation after installation, bleed air from pump as follows:

(1) Place hydraulic system control lever in general system (normal) position.

(2) Pressurize hydraulic system reservoir by manual method (see 29-00, Maintenance Practices).

(3) Open B-nut at case drain port sufficiently to allow all air to escape from pump; tighten B-nut.

4. Removal/Installation Auxiliary Hydraulic Pump

A. Remove Auxiliary Hydraulic Pump

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connector from auxiliary hydraulic pump motor.

(6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect case drain hose from case drain port.

(9) Disconnect seal cavity drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports; retain for use on new pump. Discard O-rings.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Using new O-rings, install fittings in pump ports.

(3) Fill pump case with clean Skydrol (see Paragraph 3, Servicing).

(4) Install pump on mounting bracket.

(5) Connect electrical connector to auxiliary hydraulic pump motor.

(6) Connect supply hose to suction port of pump.

(7) Connect pressure hose to pressure port of pump.

(8) Connect case drain line to case drain port.

(9) Connect seal cavity drain line to drain port.

(10) Fill hydraulic reservoir as described on instruction placard on reservoir.

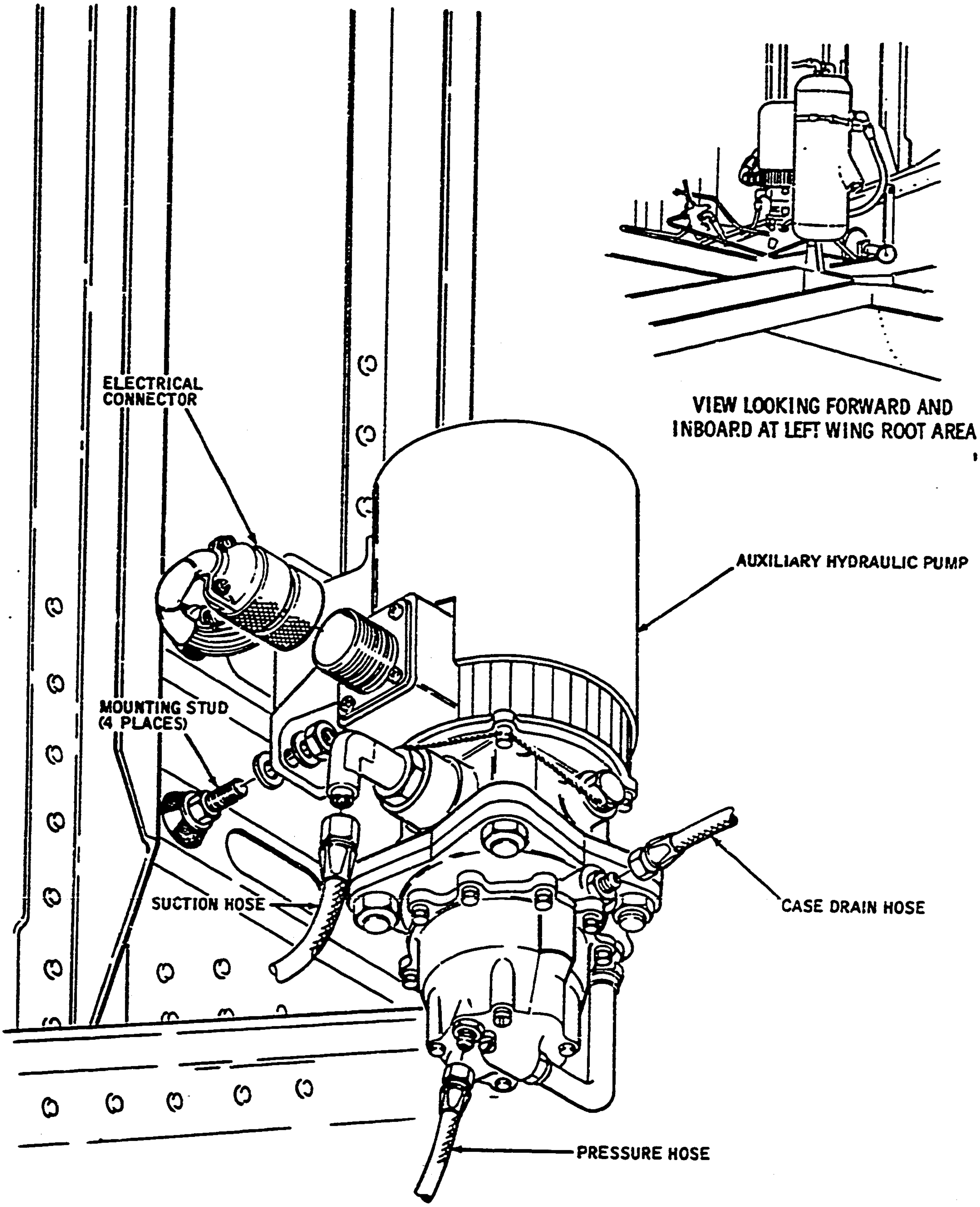
(11) Bleed air from pump case (see Paragraph 3, Servicing).

(12) Close auxiliary hydraulic pump control circuit breaker.

5. Inspection/Check Auxiliary Hydraulic Pump

A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.



Auxiliary Hydraulic Pump -- Installation
Figure 201

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(2) Place rudder and aileron hydraulic power levers in off position.

(3) Open air compressor control and water separation circuit breaker located on dc bus section of circuit breaker panel.

(4) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(5) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency) position.

<u>WARNING</u>: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

<u>CAUTION</u>: BEFORE OPERATING THE PUMP MAKE SURE THAT ALL AIR HAS BEEN BLED FROM THE PUMP AND PUMP IS COMPLETELY FULL OF SKYDROL HYDRAULIC FLUID.

<u>CAUTION</u>: DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(6) Check hydraulic system pressure indicator in flight compartment for 2600- to 3000-psi indicator.

<u>NOTE</u>: With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(7) Place auxiliary hydraulic pump switch momentarily in stop position.

(8) Check auxiliary hydraulic pump for security of attachment and leaks.

(9) Check hydraulic lines for security, clearance, and leaks.

(10) Check electrical connector on pump motor for security of attachment and condition of wiring.

(11) Close air compressor control and water separation circuit breaker.

AUXILIARY HYDRAULIC PUMP - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump is located aft of the wing rear spar in the left wing root.

B. Access to the auxiliary hydraulic pump is through the left wing root access door.

2. Tools and Equipment Required

A. Clean Skydrol hydraulic fluid is used for filling the auxiliary hydraulic pump case.

3. Servicing Auxiliary Hydraulic Pump

A. Prior to installing pump, fill pump case with clean Skydrol hydraulic fluid through case drain port.

B. Prior to operation after installation, bleed air from pump as follows:

(1) Place hydraulic system control lever in general system (normal) position.

(2) Pressurize hydraulic system reservoir by manual method (see 29-00, Maintenance Practices).

(3) Open B-nut at case drain port sufficiently to allow all air to escape from pump; tighten B-nut.

4. Removal/Installation Auxiliary Hydraulic Pump

A. Remove Auxiliary Hydraulic Pump

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connector from auxiliary hydraulic pump motor.

(6) Disconnect supply hose from suction port of auxiliary hydraulic pump.

(7) Disconnect pressure hose from pressure port of pump.

(8) Disconnect case drain hose from case drain port.

(9) Disconnect seal cavity drain line from drain port.

(10) Remove pump.

(11) Remove fittings from pump ports; retain for use on new pump. Discard O-rings.

B. Install Auxiliary Hydraulic Pump

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel is open.

(2) Using new O-rings, install fittings in pump ports.

(3) Fill pump case with clean Skydrol (see Paragraph 3, Servicing).

(4) Install pump on mounting bracket.

(5) Connect electrical connector to auxiliary hydraulic pump motor.

(6) Connect supply hose to suction port of pump.

(7) Connect pressure hose to pressure port of pump.

(8) Connect case drain line to case drain port.

(9) Connect seal cavity drain line to drain port.

(10) Fill hydraulic reservoir as described on instruction placard on reservoir.

(11) Bleed air from pump case (see Paragraph 3, Servicing).

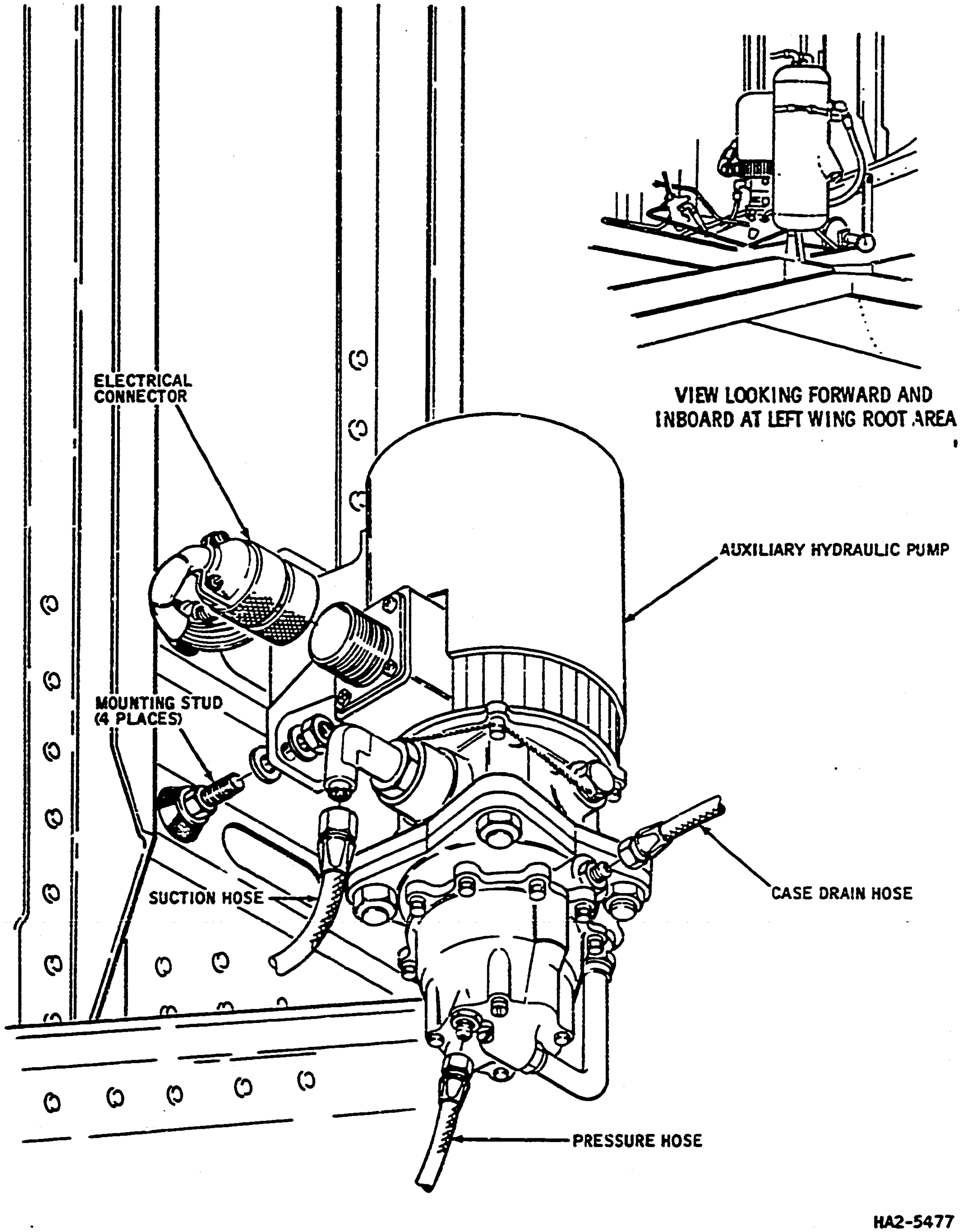
(12) Close auxiliary hydraulic pump control circuit breaker.

5. Inspection/Check Auxiliary Hydraulic Pump

A. Check Auxiliary Hydraulic Pump

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Place rudder and aileron hydraulic power levers in off position.



Auxiliary Hydraulic Pump -- Installation
Figure 201

(3) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(4) Place auxiliary hydraulic pump switch momentarily in start (hold only in emergency) position.

WARNING: BEFORE PRESSURIZING THE HYDRAULIC SYSTEM, MAKE CERTAIN THAT THE LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THAT THE LANDING GEAR LOCKPINS ARE INSTALLED. MAKE CERTAIN THAT THE THRUST REVERSERS, ALL FLIGHT CONTROL SURFACES, AND FLIGHT CONTROLS IN THE FLIGHT COMPARTMENT ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

CAUTION: BEFORE OPERATING THE PUMP MAKE SURE THAT ALL AIR HAS BEEN BLED FROM THE PUMP AND PUMP IS COMPLETELY FULL OF SKYDROL HYDRAULIC FLUID.

CAUTION: DO NOT HOLD AUXILIARY HYDRAULIC PUMP SWITCH IN START POSITION TO PERFORM PRESSURE CHECKS.

(5) Check hydraulic system pressure indicator in flight compartment for 2600- to 3000-psi indicator.

NOTE: With the hydraulic system selector valve in No. 1 (BYPASS/GENERAL SYSTEM) or No. 2 (GENERAL SYSTEM/NORMAL) position, a pressure reading of less than 2800 psi indicates more than minimum designed leakage in the hydraulic system is occurring and an effort should be made to isolate and correct the condition if time permits. Acceptable system operation can be obtained with a minimum of 2600 psi auxiliary hydraulic pump output when system selector valve is in No. 1 and No. 2 positions.

(6) Place auxiliary hydraulic pump switch momentarily in stop position.

(7) Check auxiliary hydraulic pump for security of attachment and leaks.

(8) Check hydraulic lines for security, clearance, and leaks.

(9) Check electrical connector on pump motor for security of attachment and condition of wiring.

AUXILIARY HYDRAULIC PUMP RELIEF VALVE - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump relief valve is teed into return port A on the hydraulic system reservoir, located in the left wing root area aft of the rear spar.

B. Access to the relief valve is through the left wing root access door.

2. Removal/Installation Auxiliary Hydraulic Pump Relief Valve

A. Remove Relief Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect auxiliary pump pressure line from inlet port of relief valve.

(5) Remove relief valve from reducer in T-fitting in reservoir return port A. Discard O-ring.

(6) Remove fitting from inlet port of relief valve; retain for use in new valve. Discard O-ring.

B. Install Relief Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

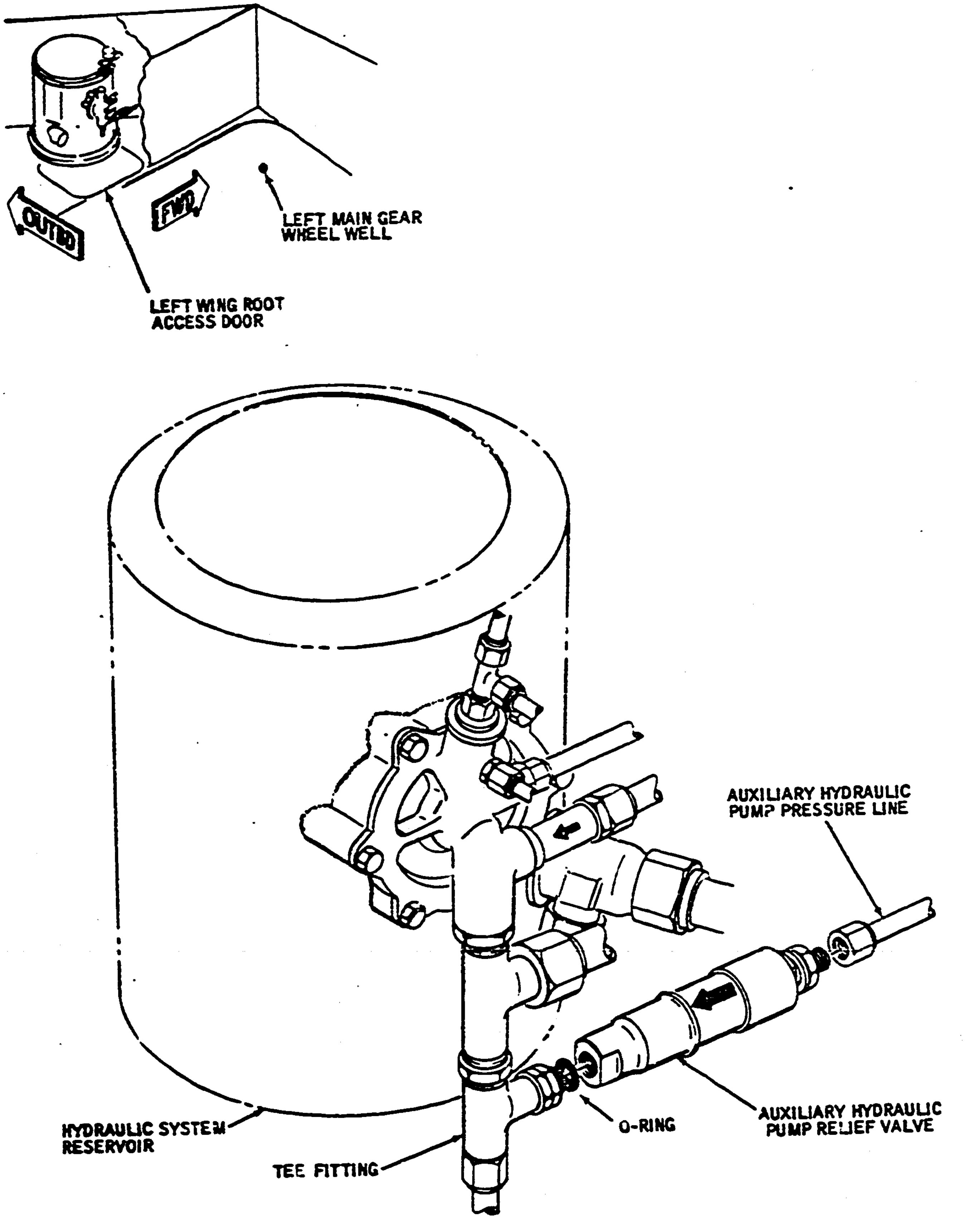
(2) Using new O-ring, install fitting in inlet port of relief valve.

(3) Using new O-ring, install relief valve in tee fitting in reservoir return port A.

CAUTION: BE CERTAIN THAT VALVE IS INSTALLED WITH ARROW POINTING TOWARD RESERVOIR.

(4) Connect auxiliary pump pressure line to inlet port of valve.

(5) Close auxiliary hydraulic pump circuit breaker.



Auxiliary Hydraulic Pump Relief Valve -- Installation
Figure 201

3. <u>Inspection/Check Auxiliary Hydraulic Pump Relief Valve</u>

A. Check Relief Valve

(1) Make certain that relief valve flow arrow (outlet port) is directed toward T-fitting in return port A of reservoir.

(2) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(3) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(4) Check relief valve, lines, and fittings for general condition and leaks.

(5) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC PUMP RELIEF VALVE - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump relief valve is teed into return port A on the hydraulic system reservoir, located in the left wing root area aft of the rear spar.

B. Access to the relief valve is through the left wing root access door.

2. Removal/Installation Auxiliary Hydraulic Pump Relief Valve

A. .Remove Relief Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect auxiliary pump pressure line from inlet port of relief valve.

(5) Remove relief valve from reducer in T-fitting in reservoir return port A. Discard O-ring.

(6) Remove fitting from inlet port of relief valve; retain for use in new valve. Discard O-ring.

B. Install Relief Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

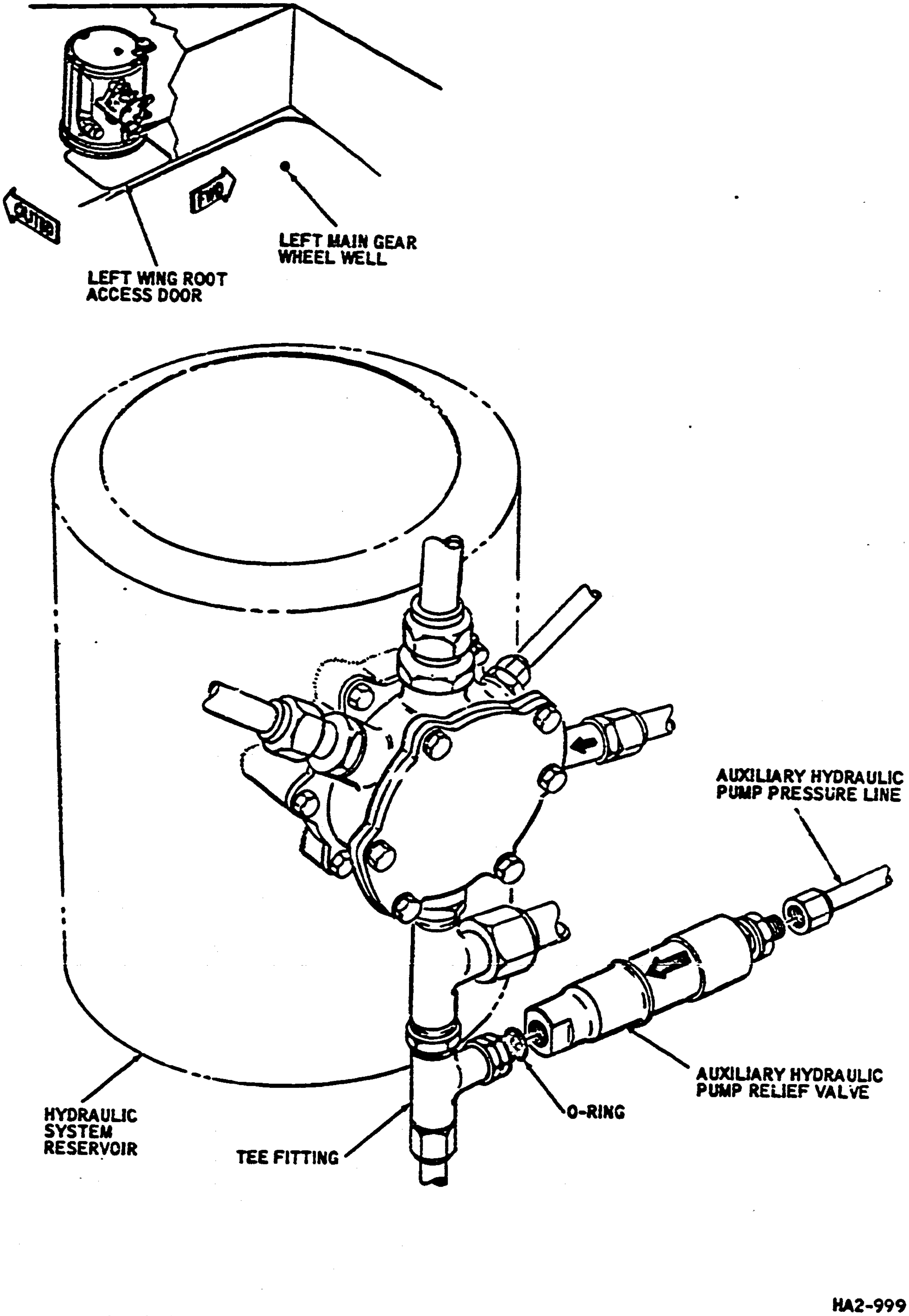
(2) Using new O-ring, install fitting in inlet port of relief valve.

(3) Using new O-ring, install relief valve in tee fitting in reservoir return port A.

CAUTION: BE CERTAIN THAT VALVE IS INSTALLED WITH ARROW POINTING TOWARD RESERVOIR.

(4) Connect auxiliary pump pressure line to inlet port of valve.

(5) Close auxiliary hydraulic pump circuit breaker.



Auxiliary Hydraulic Pump Relief Valve -- Installation
Figure 201

3. Inspection/Check Auxiliary Hydraulic Pump Relief Valve

A. Check Relief Valve

(1) Make certain that relief valve flow arrow (outlet port) is directed toward T-fitting in return port A of reservoir.

(2) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(3) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(4) Check relief valve, lines, and fittings for general condition and leaks.

(5) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC SYSTEM FILTER - MAINTENANCE PRACTICES

1. General

   A. The auxiliary hydraulic system filter is located on the forward inboard side of the left main gear wheel well, slightly inboard and above the dual filter and relief valve.

   B. Access is through the left main gear inboard door.

2. Removal/Installation Auxiliary Hydraulic System Filter

   A. Remove Filter

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect auxiliary hydraulic pump pressure lines from inlet and outlet ports of filter.

      (5) Remove filter.

      (6) Remove fittings from filter head; retain for use in new unit. Discard O-rings.

   B. Install Filter

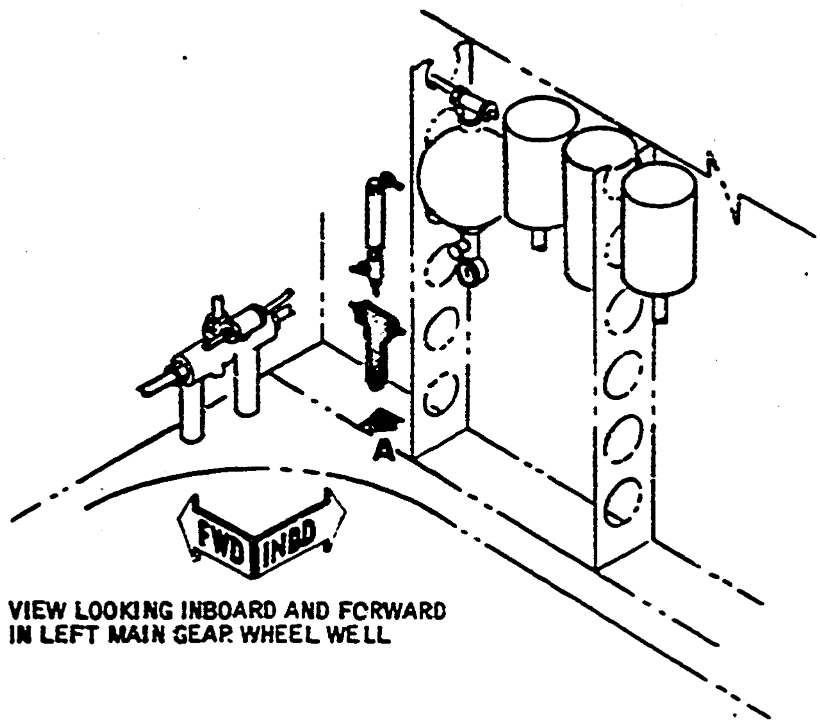
      (1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

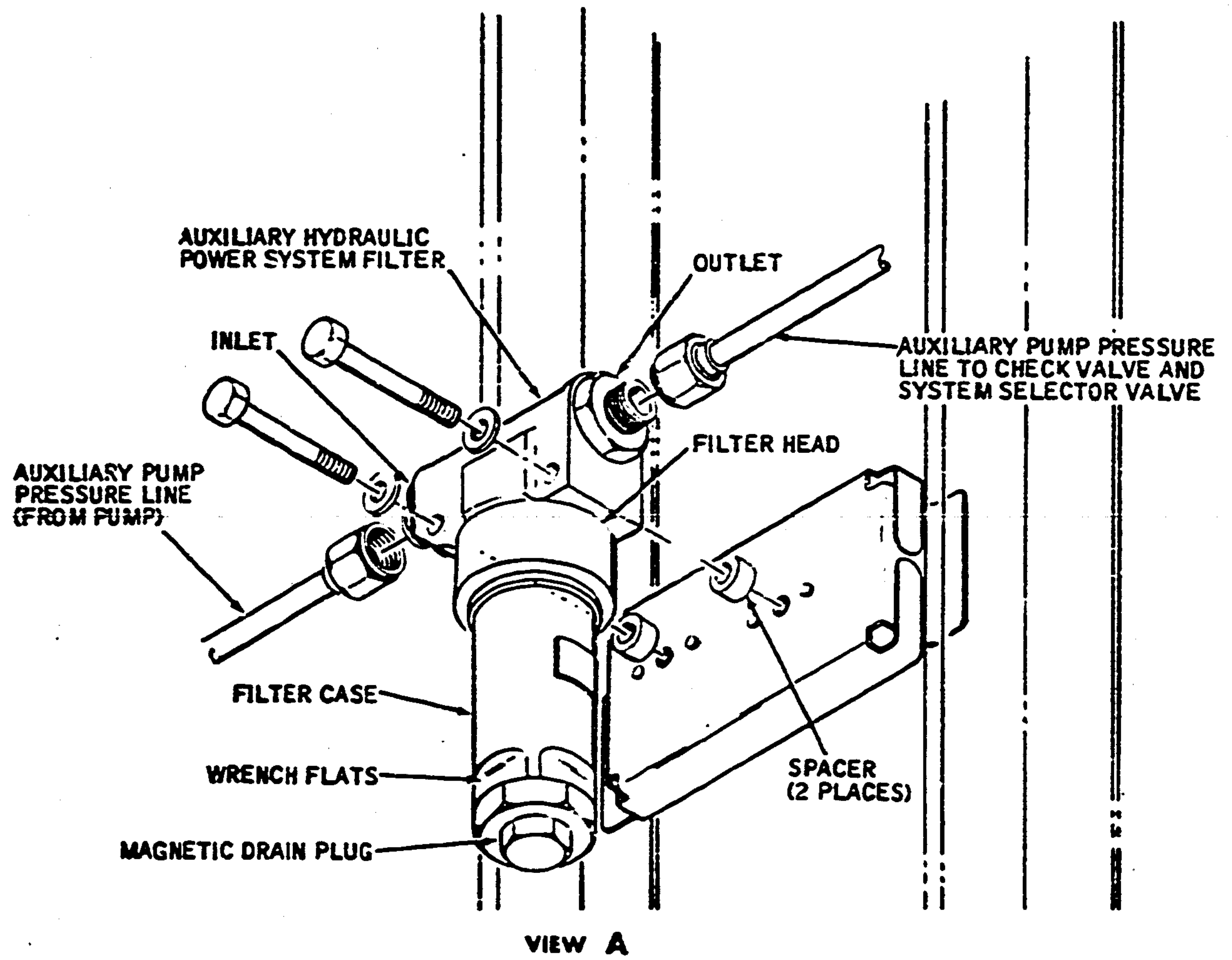
      (2) Using new O-rings, install fittings in inlet and outlet port of filter.

      (3) Install filter on bracket with inlet port forward in relation to airplane.

      (4) Connect auxiliary hydraulic pump pressure lines to filter ports.

      (5) Close auxiliary hydraulic pump control circuit breaker.





Auxiliary Hydraulic Power System Filter -- Installation
Figure 201

3. Inspection/Check Auxiliary Hydraulic System Filter

A. Check Filter

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(3) Check filter, hydraulic lines, and fittings for security of attachment, general condition, and leaks.

(4) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Remove magnetic drain plug from bottom of filter and discard O-ring. Check for metal particles which indicate impending failure of auxiliary hydraulic pump.

(6) Using new O-ring, install magnetic drain plug in bottom of filter. Tighten plug to torque of 150 (±15) inch-pounds.

(7) Safety magnetic drain plug with lockwire.

AUXILIARY HYDRAULIC SYSTEM FILTER - MAINTENANCE PRACTICES

1. General

A. On airplanes 801-811, the auxiliary hydraulic system filter is located in the left wing root, just forward of the auxiliary hydraulic pump. On airplanes 812-819, 860 and subsequent, the filter is located on the forward inboard side of the left main gear wheel well, slightly inboard and above the dual filter and relief valve.

B. On airplanes 801-811, access is through the left wing root access door. On airplanes 812-819, 860 and subsequent, access is through the left main inboard door.

2. Removal/Installation Auxiliary Hydraulic System Filter

A. Remove Filter

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect auxiliary hydraulic pump pressure lines from inlet and outlet ports of filter.

(5) Remove filter.

(6) Remove fittings from filter head; retain for use in new unit. Discard O-rings.

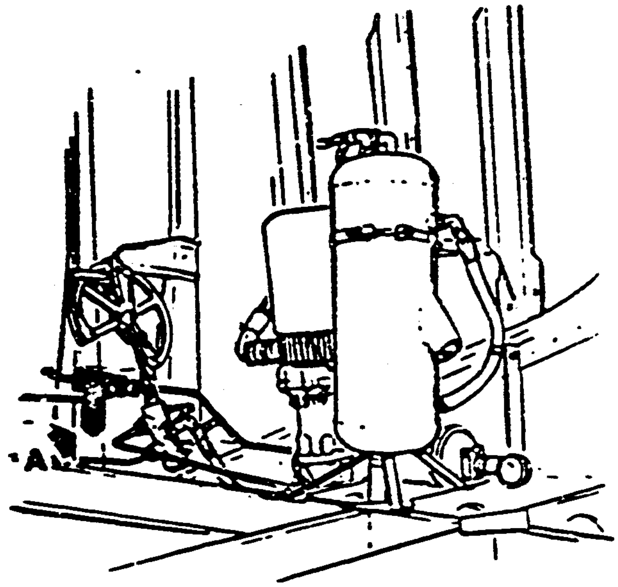
B. Install Filter

(1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

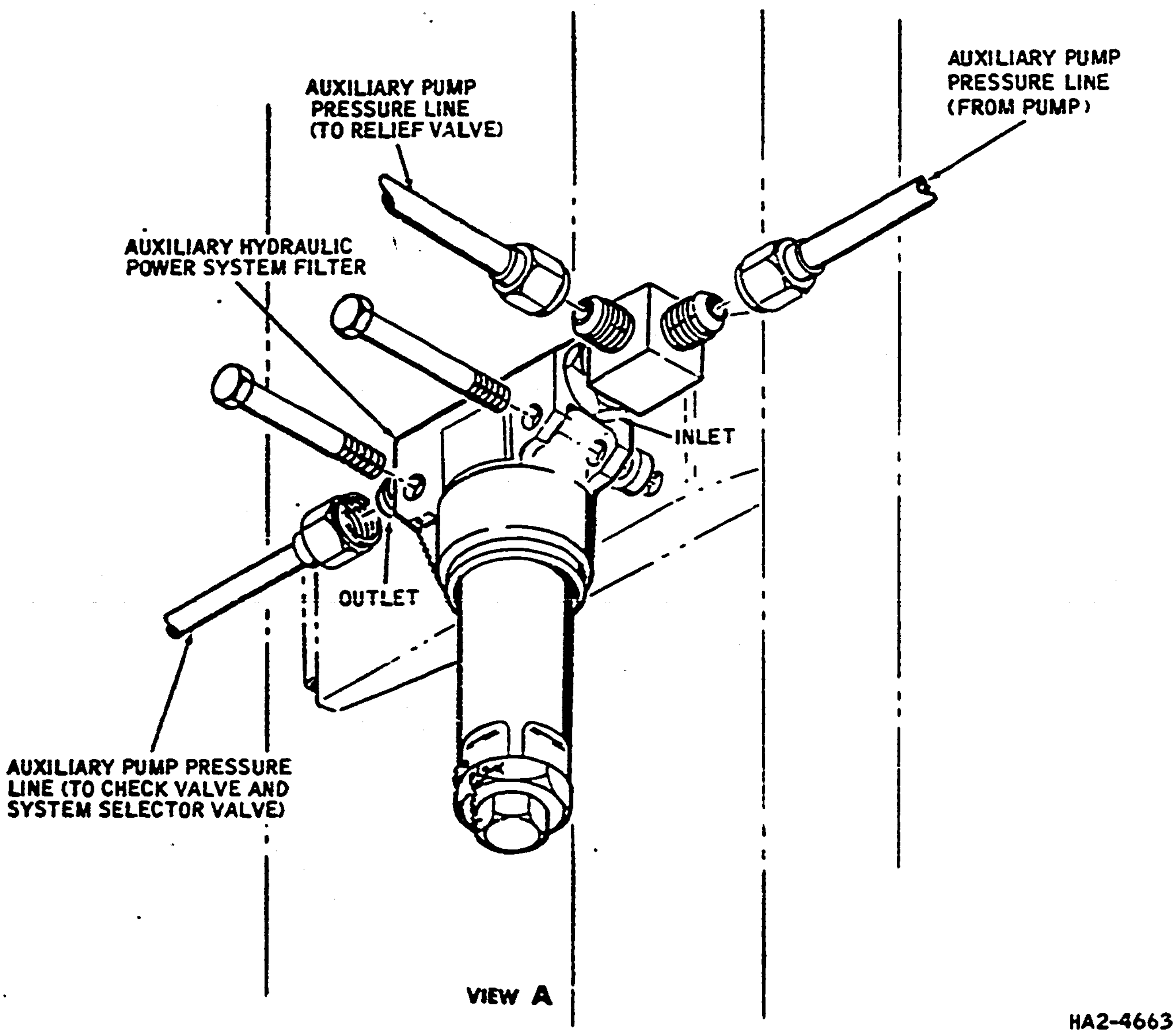
(2) Using new O-rings, install fittings in inlet and outlet port of filter.

(3) On airplanes 801-811, install filter on bracket with outlet port forward in relation to airplane.

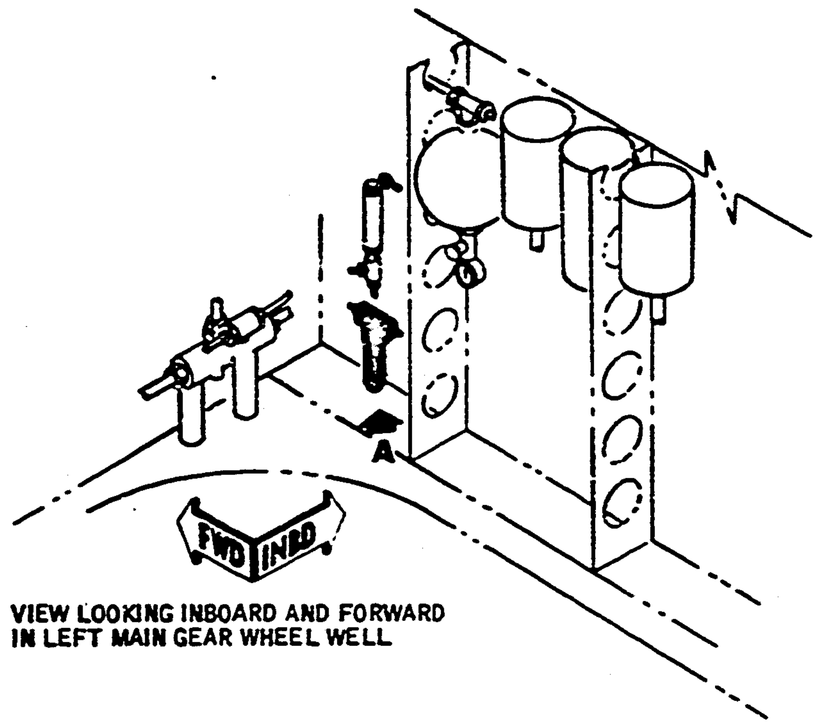
(4) On airplanes 812-819, 860 and subsequent, install filter on bracket with inlet port forward in relation to airplane.



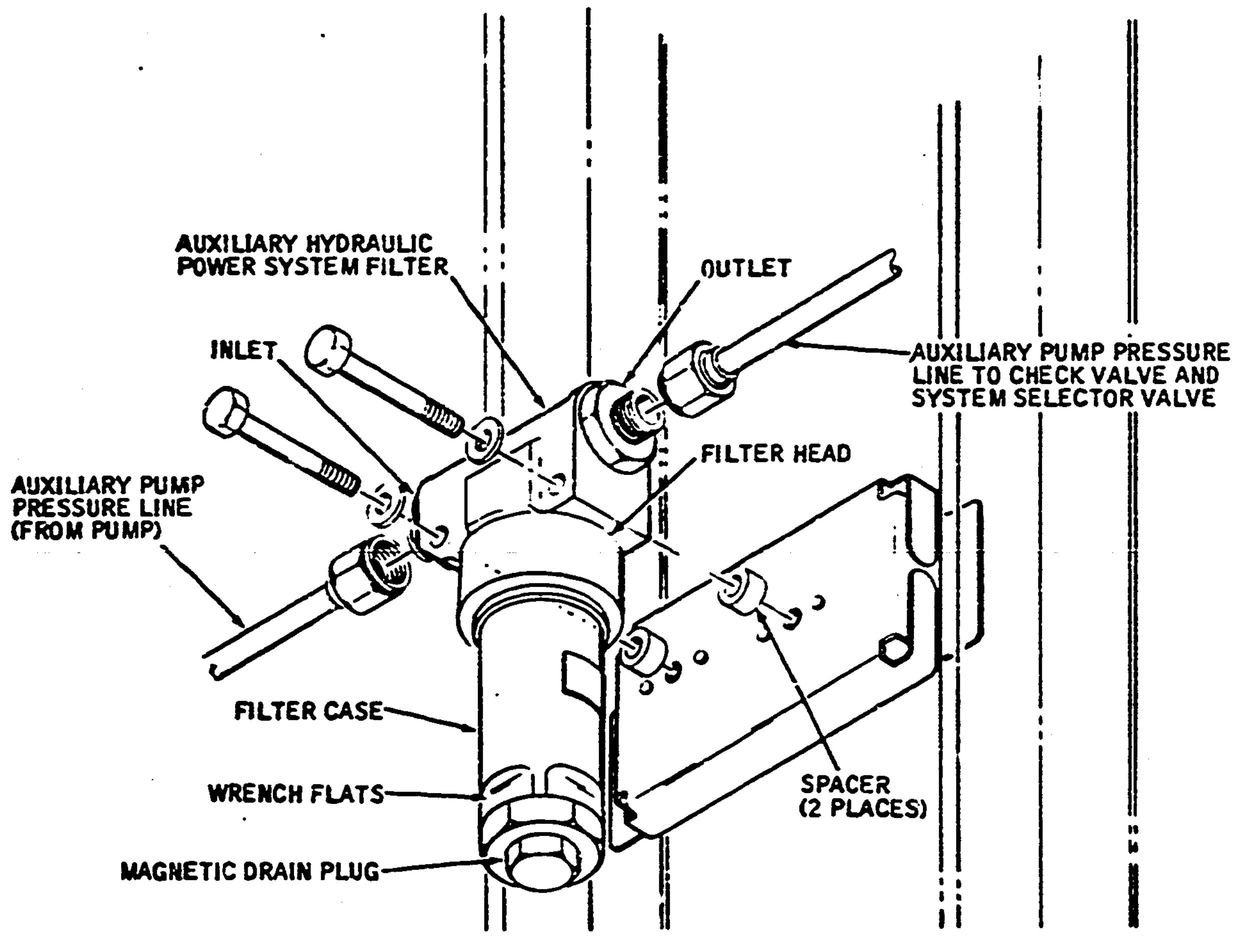
VIEW LOOKING FORWARD AND OUTBOARD
IN LEFT WING ROOT AREA



Auxiliary Hydraulic Power System Filter -- Installation
(Airplanes 801-811)
Figure 201 (Sheet 1)



VIEW LOOKING INBOARD AND FORWARD IN LEFT MAIN GEAR WHEEL WELL



VIEW A

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Auxiliary Hydraulic Power System Filter -- Installation
(Airplanes 812-822, 860 and Subsequent)
Figure 201 (Sheet 2)

(5) Connect auxiliary hydraulic pump pressure lines to filter ports.

(6) Close auxiliary hydraulic pump control circuit breaker.

3. Inspection/Check Auxiliary Hydraulic System Filter

A. Check Filter

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(3) Check filter, hydraulic lines, and fittings for security of attachment, general condition, and leaks.

(4) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

(5) Remove magnetic drain plug from bottom of filter and discard O-ring. Check for metal particles which indicate impending failure of auxiliary hydraulic pump.

(6) Using new O-ring, install magnetic drain plug in bottom of filter. Tighten plug to torque of 150 (±15) inch-pounds.

(7) Safety magnetic drain plug with lockwire.

AUXILIARY HYDRAULIC SYSTEM FILTER ELEMENT - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic system filter is located on the forward inboard side of the left main gear wheel well, slightly inboard and above the dual filter and relief valve.

B. The filter element is a stainless steel mesh, cleanable-type element. The ultrasonic method is recommended for cleaning filter elements.

C. Access is through the left main gear inboard door.

2. Tools and Equipment Required

A. Versol cleaning solvent (Federal Specification TT-T-291) is used for cleaning filter head, bowl, and magnetic drain plug.

3. Removal/Installation Auxiliary Hydraulic Filter Element

A. Remove Filter Element

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY THE CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Remove magnetic drain plug from bottom of filter bowl.

(5) Remove filter bowl from head.

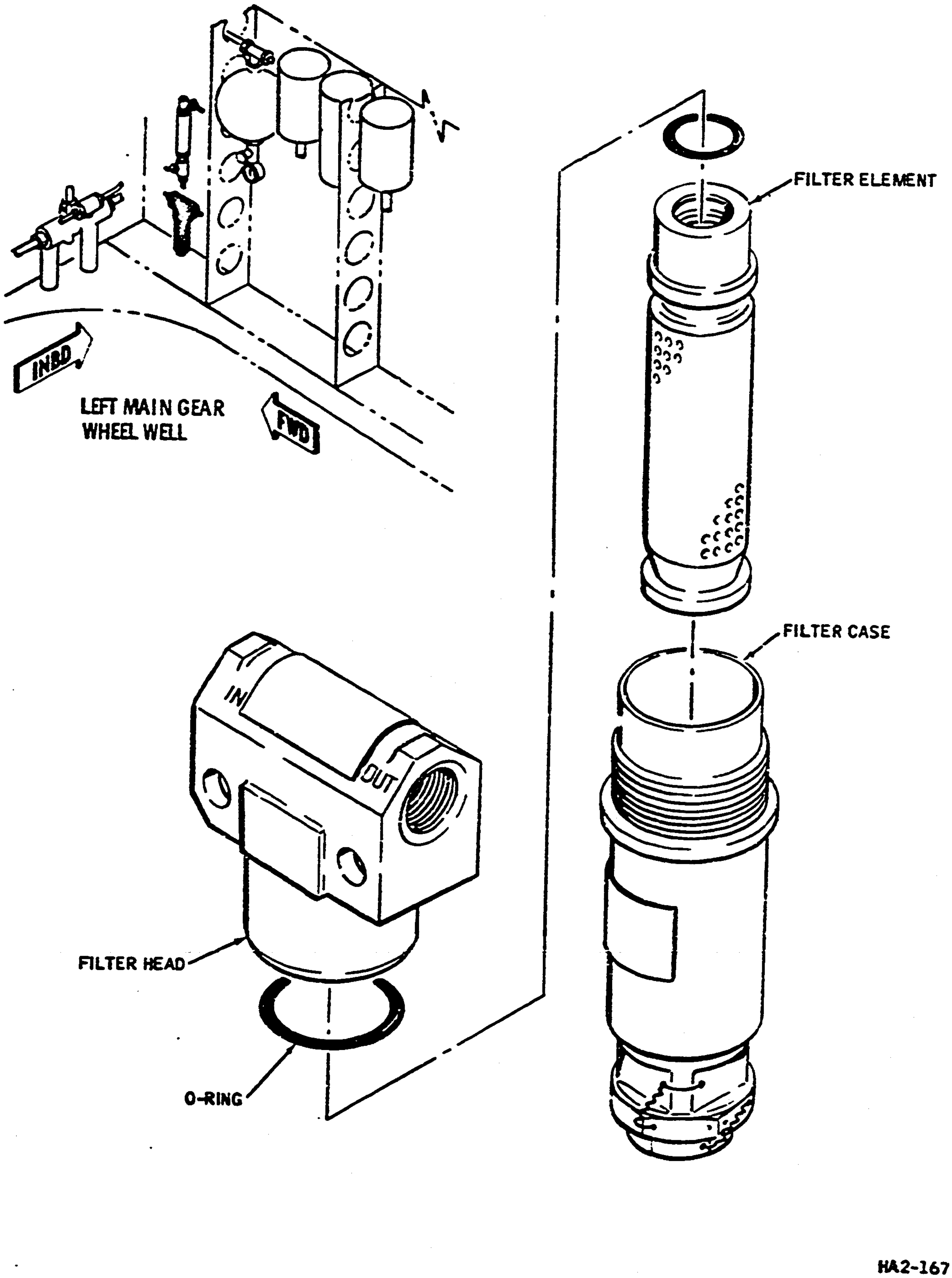
(6) Remove filter element from head.

NOTE: Grasp filter element firmly and gently rock from side to side while withdrawing the element from the head.

(7) Wash filter bowl, filter head, and magnetic drain plug with clean Varsol (Federal Specification TT-T-291) and air-dry.

(8) Clean off any magnetic particles on magnetic drain plug with clean, lint-free cloth.

CAUTION: PLACE MAGNETIC PLUG IN A CLEAN CONTAINER UNTIL READY FOR INSTALLATION IN THE FILTER CASE.



Auxiliary Hydraulic System Filter Element -- Installation
Figure 201

B. Install Filter Element

(1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

(2) Using new O-ring, install filter element into filter head.

(3) Using new O-ring, install filter bowl. Tighten bowl to torque of 120 to 180 inch-pounds and safety with lockwire.

(4) Using new O-ring, install magnetic drain plug in filter bowl. Tighten plug to torque of 150 (±15) inch-pounds and safety with lockwire.

(5) Close auxiliary hydraulic pump control circuit breaker.

4. Inspection/Check Auxiliary Hydraulic System Filter Element

A. Check Filter Element

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(3) Check filter, hydraulic lines, and fittings for security of attachment, general condition, and leaks.

(4) Check for security of safety lockwire between head and bowl, and between bowl and magnetic drain plug.

(5) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC SYSTEM FILTER ELEMENT - MAINTENANCE PRACTICES

1. General

A. On airplanes 801-811, the auxiliary hydraulic system filter is located in the left wing root, just forward of the auxiliary hydraulic pump. On airplanes 812-822, 860 and subsequent, the filter is located on the forward inboard side of the left main gear wheel well, slightly inboard and above the dual filter and relief valve.

B. On airplanes 801-811, access is through the left wing root access door. On airplanes 812-822, 860 and subsequent, access is through the left main gear inboard door.

C. The filter element is a stainless steel mesh, cleanable-type element. The ultrasonic method is recommended for cleaning filter elements.

2. Tools and Equipment Required

A. Varsol cleaning solvent (Federal Specification TT-T-291) is used for cleaning filter head, bowl, and magnetic drain plug.

3. Removal/Installation Auxiliary Hydraulic Filter Element

A. Remove Filter Element

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY THE CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

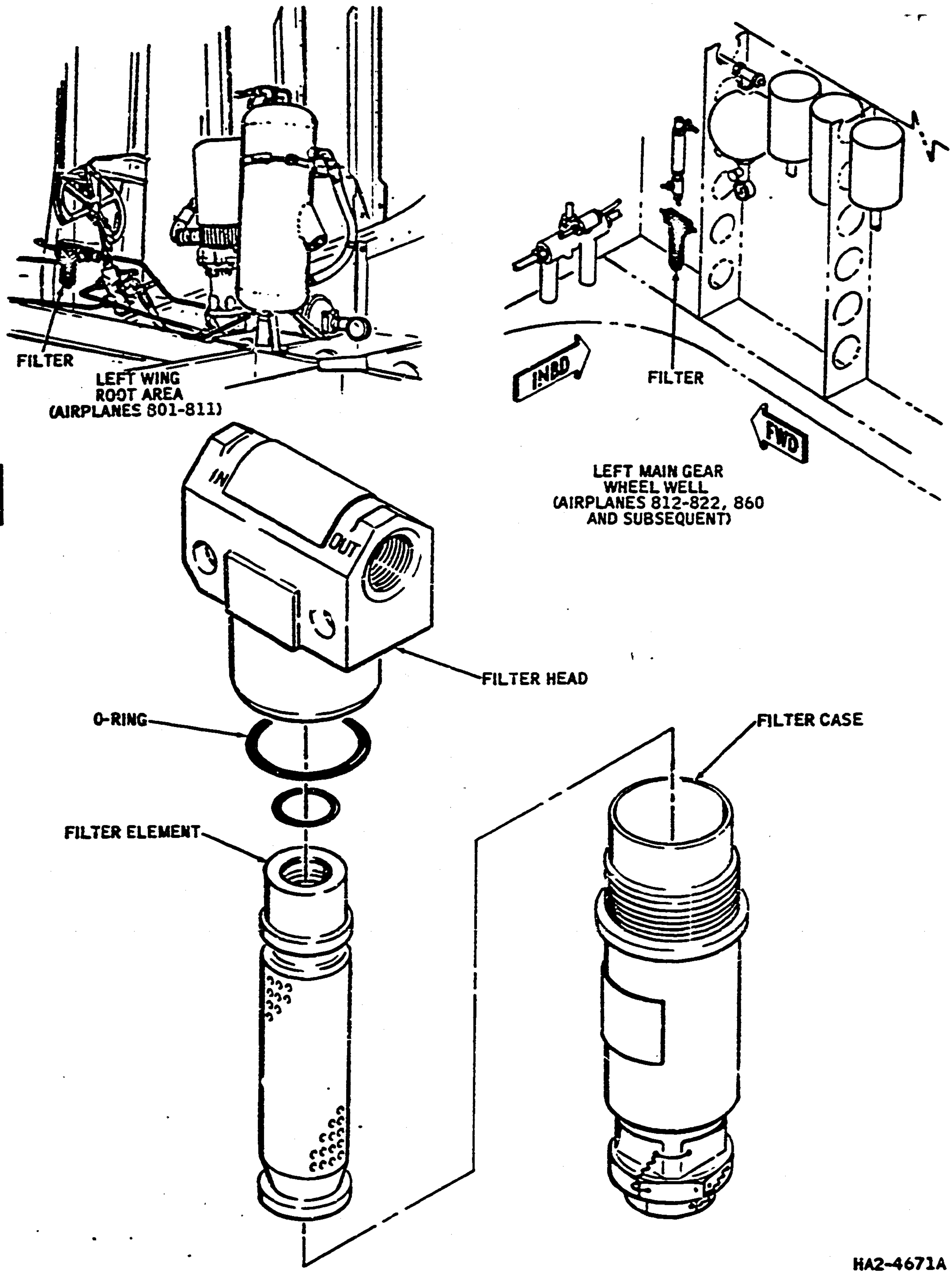
(4) Remove magnetic drain plug from bottom of filter bowl.

(5) Remove filter bowl from head.

(6) Remove filter element from head.

NOTE: Grasp filter element firmly and gently rock from side to side while withdrawing the element from the head.

(7) Wash filter bowl, filter head, and magnetic drain plug with clean Varsol (Federal Specification TT-T-291) and air-dry.



Auxiliary Hydraulic System Filter Element -- Installation
Figure 201

(8) Clean off any magnetic particles on magnetic drain plug with clean, lint-free cloth.

CAUTION: PLACE MAGNETIC PLUG IN A CLEAN CONTAINER UNTIL READY FOR INSTALLATION IN THE FILTER CASE.

B. Install Filter Element

(1) Make certain that auxiliary hydraulic pump control circuit breaker, located on EPC circuit breaker panel is open.

(2) Using new O-ring, install filter element into filter head.

(3) Using new O-ring, install filter bowl. Tighten bowl to torque of 120 to 180 inch-pounds and safety with lockwire.

(4) Using new O-ring, install magnetic drain plug in filter bowl. Tighten plug to torque of 150 (±15) inch-pounds and safety with lockwire.

(5) Close auxiliary hydraulic pump control circuit breaker.

4. Inspection/Check Auxiliary Hydraulic System Filter Element

A. Check Filter Element

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(3) Check filter, hydraulic lines, and fittings for security of attachment, general condition, and leaks.

(4) Check for security of safety lockwire between head and bowl, and between bowl and magnetic drain plug.

(5) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC SYSTEM CHECK VALVE - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic system check valve is located in the left main gear wheel well aft of the rear spar and just above the auxiliary hydraulic system filter.

B. Access to the check valve is through the left main gear inboard door.

2. Removal/Installation Auxiliary Hydraulic System Check Valve

A. Remove Check Valve

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect line from each end of check valve.

(5) Remove check valve.

B. Install Check Valve

(1) Make certain that auxiliary hydraulic pump control circuit breaker located on cabin bus 4 is open.

(2) Install check valve.

CAUTION: BE CERTAIN THAT VALVE IS INSTALLED WITH FLOW ARROW POINTING INBOARD.

(3) Connect hydraulic pressure lines to each port of check valve.

(4) Close auxiliary hydraulic pump control circuit breaker.

3. Inspection/Check Auxiliary Hydraulic System Check Valve

A. Check Check Valve

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(3) Check check valve for proper direction of flow arrow and for leaks.

(4) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC SYSTEM SURGE DAMPER ACCUMULATOR - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic system surge damper accumulator is located in the left wing root area just inboard of the auxiliary hydraulic pump alternate reservoir.

B. Access to the surge damper accumulator is through the left wing root access door.

2. Tools and Equipment Required

A. Pressure cylinder (clean, dry, compressed nitrogen).

3. Service Auxiliary Hydraulic System Surge Damper Accumulator

A. Check Auxiliary Hydraulic System Surge Damper Accumulator Pressure

(1) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(2) Check accumulator gage pressure; gage should indicate 1000 psi.

(3) If accumulator requires additional pressurization, proceed as follows:

(a) Remove filler valve cap.

(b) Attach nitrogen service hose chuck to filler valve stem.

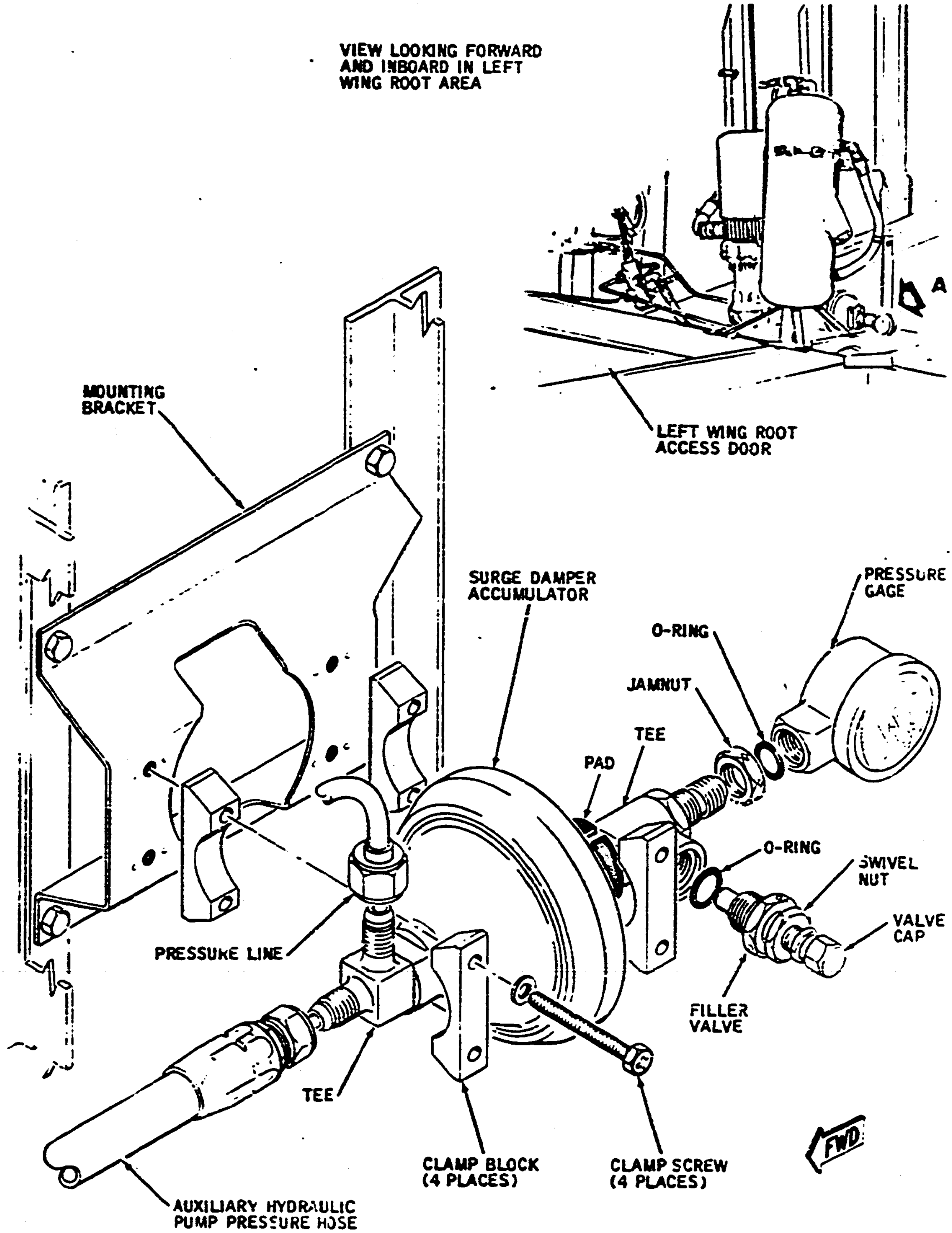
(c) Loosen filler valve swivel nut a maximum of 3/4 turn.

(d) Charge accumulator with dry nitrogen to 1000 (±50) psi.

(e) Tighten swivel nut to torque of 50 to 70 inch-pounds.

(f) Remove service hose.

(g) Install valve cap; tighten to maximum fingertightness.



Auxiliary Hydraulic System Surge Damper
Accumulator -- Installation
Figure 201

4. Removal/Installation Auxiliary Hydraulic System Surge Damper Accumulator

A. Remove Accumulator

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Relieve nitrogen pressure from accumulator as follows:

(a) Remove filler valve cap.

(b) Loosen filler valve swivel nut a maximum of 3/4 turn.

(c) Depress filler valve core and hold until pressure has bled off to zero; release valve core and tighten swivel nut.

(d) Install filler valve cap.

(5) Disconnect auxiliary hydraulic pump pressure hose from T-fitting at base of accumulator.

(6) Disconnect pressure line from T-fitting.

(7) Remove T-fitting from accumulator and retain for use in new unit. Discard O-ring.

(8) Remove clamp blocks and remove accumulator.

(9) Remove filler valve and pressure gage and retain for use in new unit. Discard O-ring.

B. Install Accumulator

(1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

(2) Using new O-ring, install T-fitting in hydraulic pressure port.

(3) Using new O-rings, install filler valve and pressure gage in nitrogen pressure port fitting.

(4) Place accumulator in position and secure with clamp blocks.

NOTE: Make certain that gage and filler valve are accessible after installation.

(5) Connect pressure line to T-fitting.

(6) Connect auxiliary hydraulic pump pressure hose to T-fitting.

(7) Charge accumulator with dry nitrogen (see paragraph 3).

(8) Close auxiliary hydraulic pump control circuit breaker.

5. Inspection/Check Auxiliary Hydraulic System Surge Damper Accumulator

A. Check Accumulator

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

(3) Check auxiliary hydraulic pump pressure hose and pressure line fittings at accumulator T-fitting for security of attachment and leaks.

(4) Check accumulator pressure gage for 2600- to 3000-psi indication.

(5) Check nitrogen port, filler valve, and pressure gage for nitrogen leaks.

(6) Shut down auxiliary hydraulic pump and depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC PUMP ALTERNATE RESERVOIR - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump alternate reservoir is located in the left wing root area just aft of the auxiliary hydraulic pump.

B. Access to the alternate reservoir is through the left wing root access door.

2. Servicing

A. Filling Procedure

NOTE: The auxiliary hydraulic pump alternate reservoir is filled and maintained in a filled condition by return fluid flow from the wing flap system.

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IN DOWN POSITION AND LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Cycle wing flaps by placing wing flap control handle in up and down positions until hydraulic fluid can be seen in alternate reservoir sight gage.

WARNING: MAKE CERTAIN THAT WING FLAP AREAS ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS BEFORE CYCLING FLAPS.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

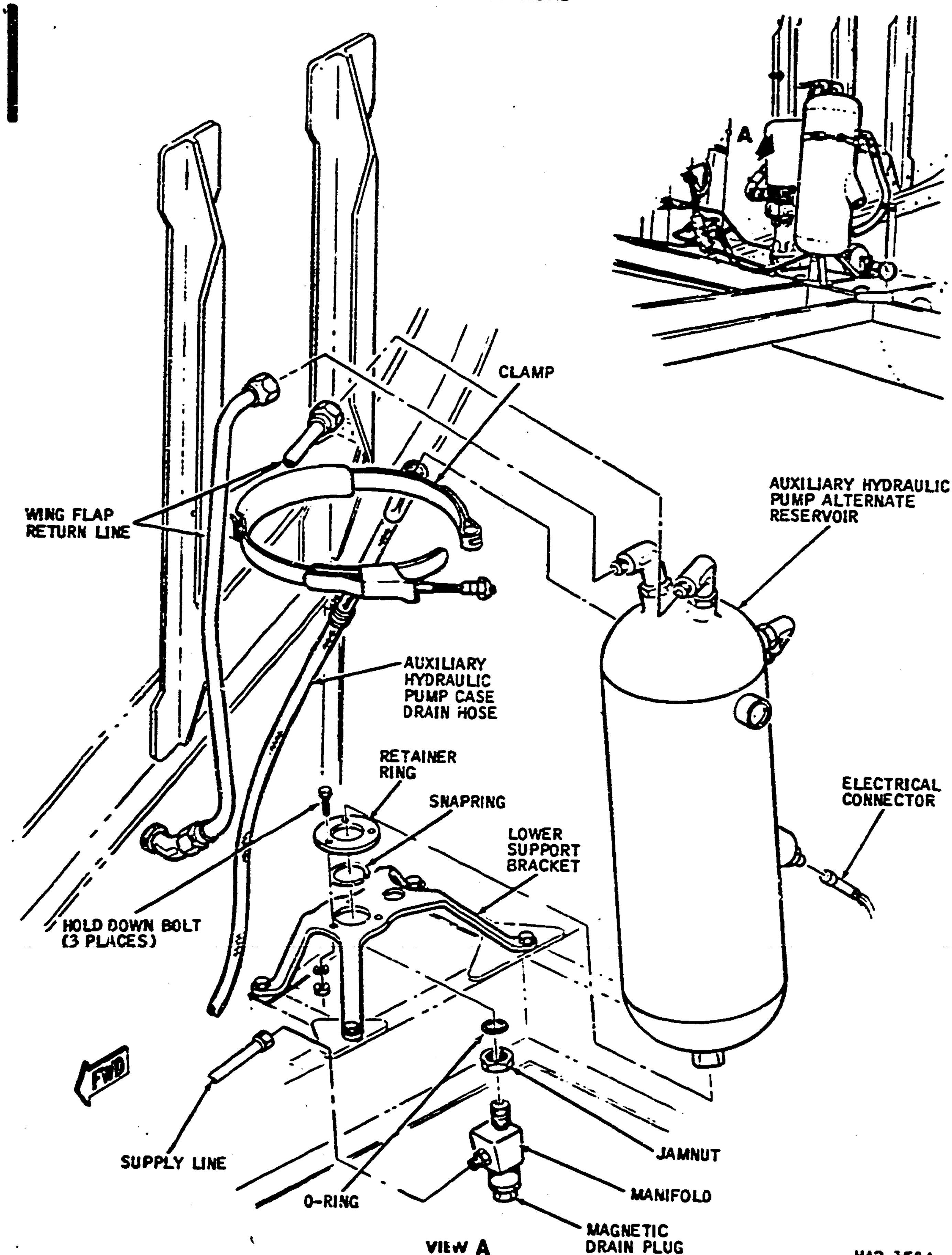
(5) Fill hydraulic system reservoir as described on instruction placard on reservoir.

3. Removal/Installation Auxiliary Hydraulic Pump Alternate Reservoir

A. Remove Alternate Reservoir

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel and hydraulic system over-temperature rudder and aileron manual indicator circuit breaker located on dc bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).



Auxiliary Hydraulic Pump Alternate
Reservoir -- Installation
Figure 201

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(4) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(5) Drain auxiliary hydraulic pump alternate reservoir (see 29-00, Maintenance Practices).

(6) Disconnect supply line from alternate reservoir magnetic plug manifold.

(7) Disconnect auxiliary pump case drain line at reservoir bypass port.

(8) Disconnect electrical connector from emergency hydraulic reservoir low level indicating light switch.

(9) Disconnect lines from top of reservoir.

(10) Remove holddown bolts from retainer ring at lower support bracket.

(11) Loosen clamp on upper support bracket and remove reservoir.

(12) Remove fittings from reservoir; retain for use in new unit. Discard O-rings.

B. Install Alternate Reservoir

(1) Make certain that auxiliary hydraulic pump control and hydraulic system overtemperature rudder and aileron manual indicator circuit breakers are open.

(2) Using new O-rings, install fittings in reservoir.

(3) Position reservoir in support bracket with sight gage facing outboard. Tighten clamp on upper support bracket.

(4) Install holddown bolts in lower support bracket retainer ring.

(5) Connect lines at top of reservoir.

(6) Connect case drain line to port in side of reservoir.

(7) Connect supply line to magnetic drain plug manifold.

(8) Connect emergency hydraulic reservoir low level indicating light switch electrical connector.

(9) Install magnetic drain plug in manifold at bottom of reservoir. Tighten to torque of 312 (±20) inch-pounds. Safety with lockwire.

(10) Close auxiliary hydraulic pump control and hydraulic overtemperature rudder and aileron manual indicator circuit breakers.

4. Inspection/Check Auxiliary Hydraulic Pump Alternate Reservoir

A. Check Alternate Reservoir

(1) Check emergency hydraulic level indicating light; it should be on when alternate reservoir is empty or below 0.8 gallons (0.666 Imperial gallons, 3.15 liters).

(2) Make certain that hydraulic system selector control lever is in general system (normal) position.

(3) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THE LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(4) Cycle wing flaps by placing wing flap control handle in up and down positions until hydraulic fluid can be seen in alternate reservoir sight gage.

WARNING: MAKE CERTAIN THAT WING FLAP AREAS ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS BEFORE CYCLING FLAPS.

(5) Check that emergency hydraulic reservoir low lever light is off when hydraulic fluid is visible in alternate reservoir sight gage.

(6) Check hydraulic fittings on reservoir and auxiliary hydraulic pump selector valve for leaks.

(7) Check electrical connector on hydraulic level switch for security of attachment and check wiring for general condition, routing, and clearance.

(8) Check all hydraulic lines in area for security of attachment and general condition.

(9) Check magnetic drain plug for safety lockwire.

(10) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(11) Fill hydraulic system reservoir as described on instruction placard on reservoir.

AUXILIARY HYDRAULIC PUMP ALTERNATE RESERVOIR - MAINTENANCE PRACTICES

1. General

A. The auxiliary hydraulic pump alternate reservoir is located in the left wing root area just aft of the auxiliary hydraulic pump.

B. Access to the alternate reservoir is through the left wing root access door.

2. Servicing

A. Filling Procedure

NOTE: The auxiliary hydraulic pump alternate reservoir is filled and maintained in a filled condition by return fluid flow from the wing flap system.

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IN DOWN POSITION AND LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Cycle wing flaps by placing wing flap control handle in up and down positions until hydraulic fluid can be seen in alternate reservoir sight gage.

WARNING: MAKE CERTAIN THAT WING FLAP AREAS ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS BEFORE CYCLING FLAPS.

(4) Depressurize hydraulic system (see 29-00, Maintenance Practices).

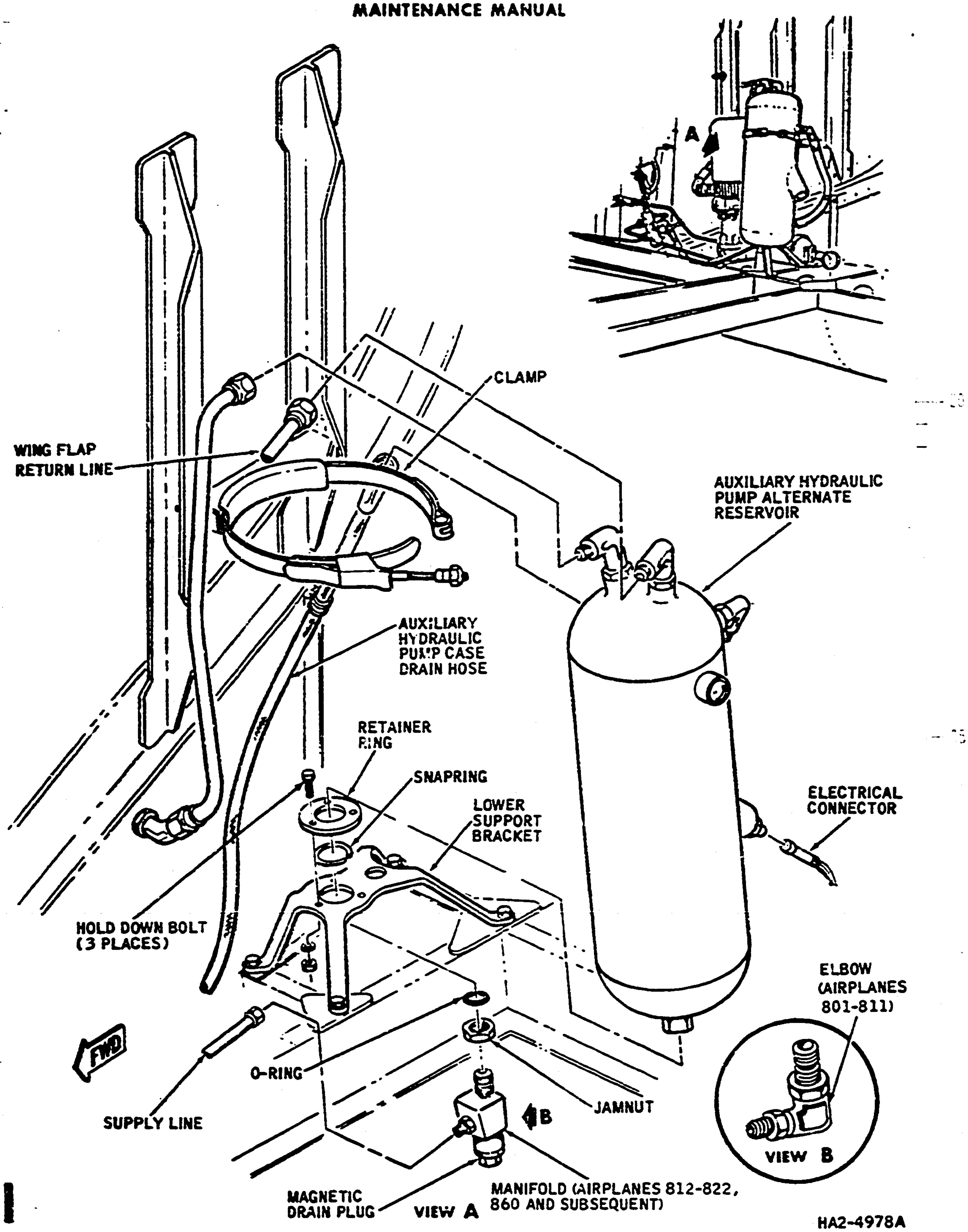
(5) Fill hydraulic system reservoir as described on instruction placard on reservoir.

3. Removal/Installation Auxiliary Hydraulic Pump Alternate Reservoir

A. Remove Alternate Reservoir

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel and hydraulic system overtemperature rudder and aileron manual indicator circuit breaker located on dc bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).



Auxiliary Hydraulic Pump Alternate Reservoir -- Installation
Figure 201

(2) Place hydraulic system selector control lever in general system (normal) position.

(3) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(4) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(5) Drain auxiliary hydraulic pump alternate reservoir (see 29-00, Maintenance Practices).

(6) Disconnect supply line from bottom of alternate reservoir.

(7) Disconnect auxiliary pump bypass line at reservoir bypass port.

(8) Disconnect electrical connector from emergency hydraulic reservoir low lever indicating light switch.

(9) Disconnect lines from top of reservoir.

(10) Remove holddown bolts from retainer ring at lower support bracket.

(11) Loosen clamp on upper support bracket and remove reservoir.

(12) Remove fittings from reservoir; retain for use in new unit. Discard O-rings.

B. Install Alternate Reservoir

(1) Make certain that auxiliary hydraulic pump control and hydraulic system overtemperature rudder and aileron manual indicator circuit breakers, located on EPC circuit breaker panel, are open.

(2) Using new O-rings, install fittings in reservoir.

(3) Position reservoir in support bracket with sight gage facing outboard. Tighten lamp on upper support bracket.

(4) Install holddown bolts in lower support bracket retainer ring.

(5) Connect lines at top of reservoir.

(6) Connect bypass line to port in side of reservoir.

(7) Connect supply line to bottom of reservoir.

(8) Connect emergency hydraulic reservoir low level indicating light switch electrical connector.

(9) On airplanes 812 - 822, 860 and subsequent, install magnetic drain plug in manifold at bottom of reservoir. Tighten to torque of 312 (±20) inch-pounds. Safety with lockwire.

(10) Close auxiliary hydraulic pump control and hydraulic overtemperature rudder and aileron manual indicator circuit breakers.

4. Inspection/Check Auxiliary Hydraulic Pump Alternate Reservoir

A. Check Alternate Reservoir

(1) Check emergency hydraulic level indicating light; it should be on when alternate reservoir is empty or below 0.8 gallon (0.666 Imperial gallons, 3.15 liters).

(2) Make certain that hydraulic system selector control lever is in general system (normal) position.

(3) Pressurize hydraulic system (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THE LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(4) Cycle wing flaps by placing wing flap control handle in up and down positions until hydraulic fluid can be seen in alternate reservoir sight gage.

WARNING: MAKE CERTAIN THAT WING FLAP AREAS ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS BEFORE CYCLING FLAPS.

(5) Check that emergency hydraulic reservoir low lever light is off when hydraulic fluid i- visible in alternate reservoir sight gage.

(6) Check hydraulic fittings on reservoir and auxiliary hydraulic pump selector valve for leaks.

(7) Check electrical connector on hydraulic level switch for security of attachment and check wiring for general condition, routing, and clearance.

(8) Check all hydraulic lines in area for security of attachment and general condition.

(9) On airplanes 812-822, 860 and subsequent, check magnetic drain plug for safety lockwire.

(10) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(11) Fill hydraulic system reservoir as described on instruction placard on reservoir.

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GROUND SERVICE PRESSURE AND SUPPLY CONNECTORS - MAINTENANCE PRACTICES

1. General

A. The ground service pressure and supply connectors are located on the floor, in the left wing root, aft of the wing rear spar.

B. Access to the pressure and supply connector is through the wing root access door.

2. Removal/Installation Ground Service Pressure and Supply Connectors

A. Remove Ground Service Pressure Connector

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Disconnect hydraulic pressure line from ground service pressure connector.

(5) Remove ground service pressure connector.

B. Install Ground Service Pressure Connector

(1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

(2) Install ground service pressure connector.

(3) Connect hydraulic pressure line to ground service pressure connector.

(4) Close auxiliary hydraulic pump control circuit breaker.

C. Remove Ground Service Supply Connector

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Remove mounting screws, loosen jamnut, and remove ground service supply connector from T-fitting in supply line. Discard O-ring.

D. Install Ground Service Supply Connector

(1) Make certain that auxiliary hydraulic pump control circuit breaker is open.

(2) Install new O-ring on ground service supply connector and screw connector into T-fitting in supply line.

(3) Install mounting screws through connector flange.

(4) Tighten jamnut.

(5) Fill reservoir as described on instruction placard on reservoir.

(6) Close auxiliary hydraulic pump control circuit breaker.

3. Inspection/Check Ground Service Pressure and Supply Connectors

(1) Pressurize hydraulic system with test stand (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Check ground service connectors for general condition, security of attachment and leaks.

(3) Shut down test stand and depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC PUMP CONTROL - MAINTENANCE PRACTICES

1. Inspection/Check Auxiliary Hydraulic Pump Control

   A. Check Auxiliary Hydraulic Pump Control

      (1) Place hydraulic system selector control lever in general system (normal) position.

      (2) Momentarily place auxiliary hydraulic pump control switch in start (hold only in emergency) position.

      WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

      (3) Auxiliary pump on indicating light should come on.

      (4) Hydraulic system pressure indicator should indicate 2800 to 3000 psi.

      (5) Momentarily place auxiliary hydraulic pump control switch in stop position.

      (6) Auxiliary hydraulic pump should stop, auxiliary pump on indicating light should go off, and hydraulic system pressure should gradually fall off.

      (7) Depressurize hydraulic system (see 29-00, Maintenance Practices).

AUXILIARY HYDRAULIC PUMP CONTROL - MAINTENANCE PRACTICES

1. Inspection/Check Auxiliary Hydraulic Pump Control

A. Check Auxiliary Hydraulic Pump Control

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Momentarily place auxiliary hydraulic pump control switch in start (hold only in emergency) position.

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

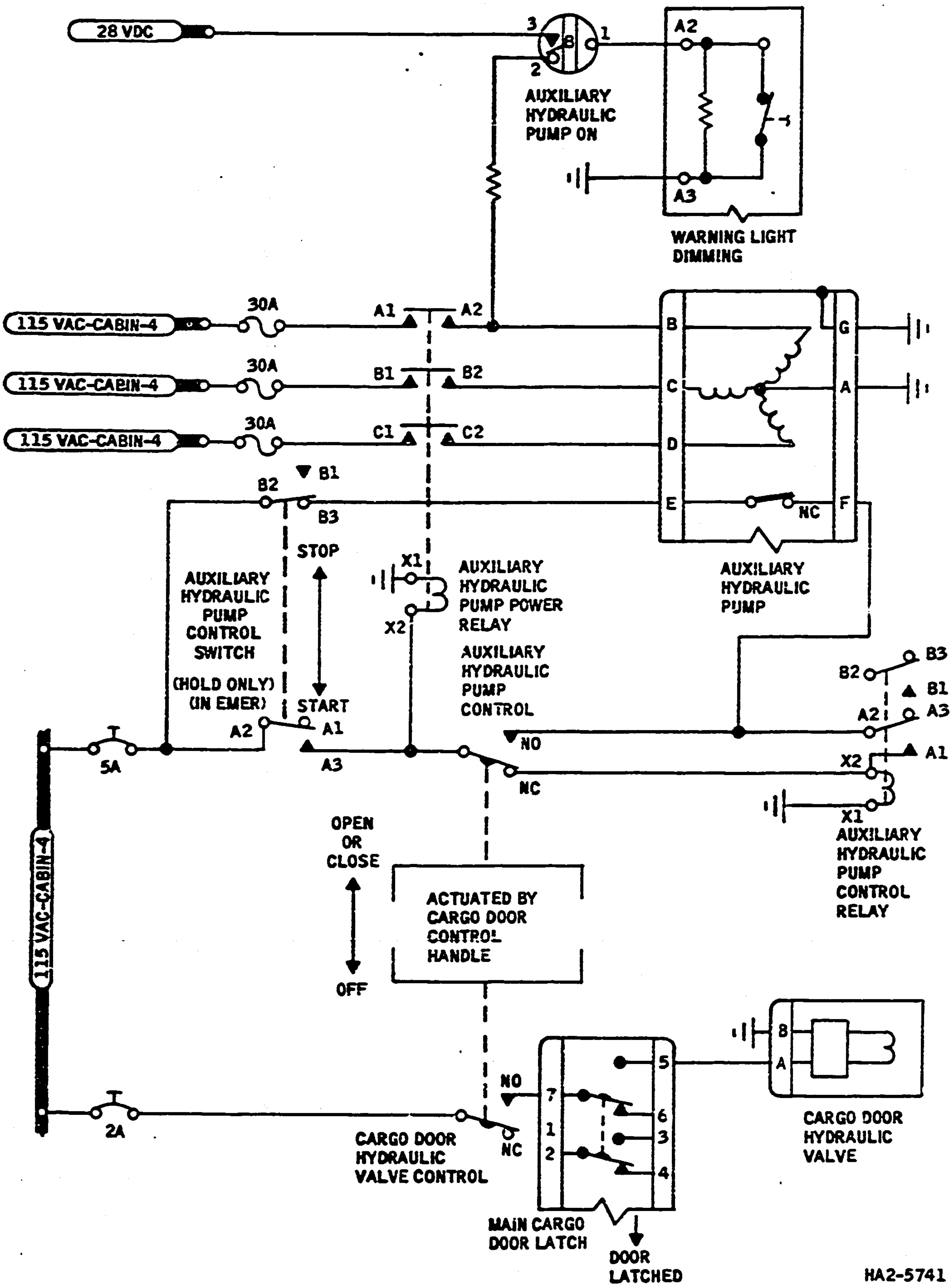
(3) Auxiliary pump on indicating light should come on.

(4) Hydraulic system pressure indicator should indicate 2800 to 3000 psi.

(5) Momentarily place auxiliary hydraulic pump control switch in stop position.

(6) Auxiliary hydraulic pump should stop, auxiliary pump on indicating light should go off, and hydraulic system pressure should gradually fall off.

(7) Depressurize hydraulic system (see 29-00, Maintenance Practices).



Auxiliary Hydraulic Pump Control System -- Schematic
(Airplanes 812 - 815)
Figure 1 (Sheet 1)

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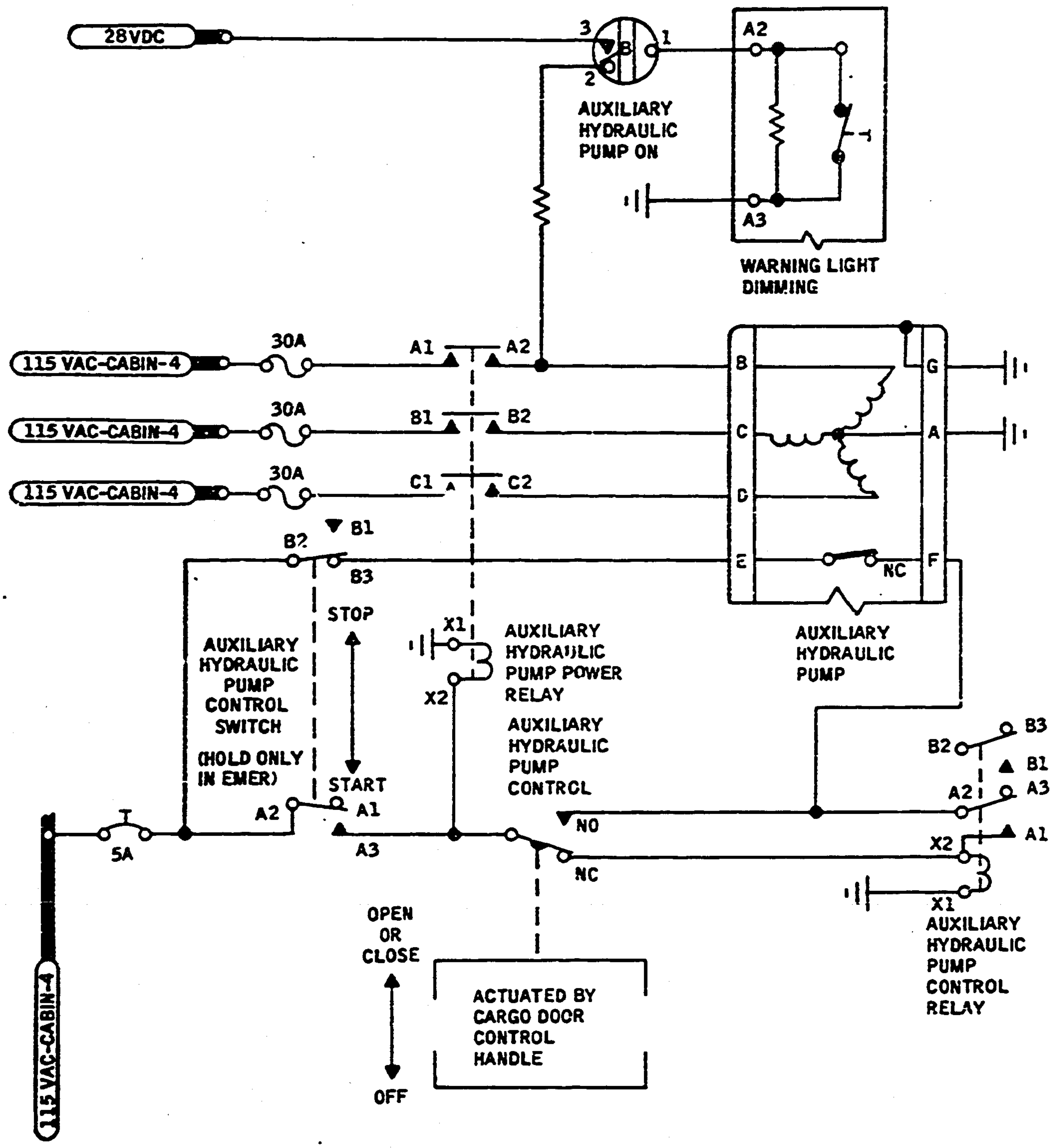
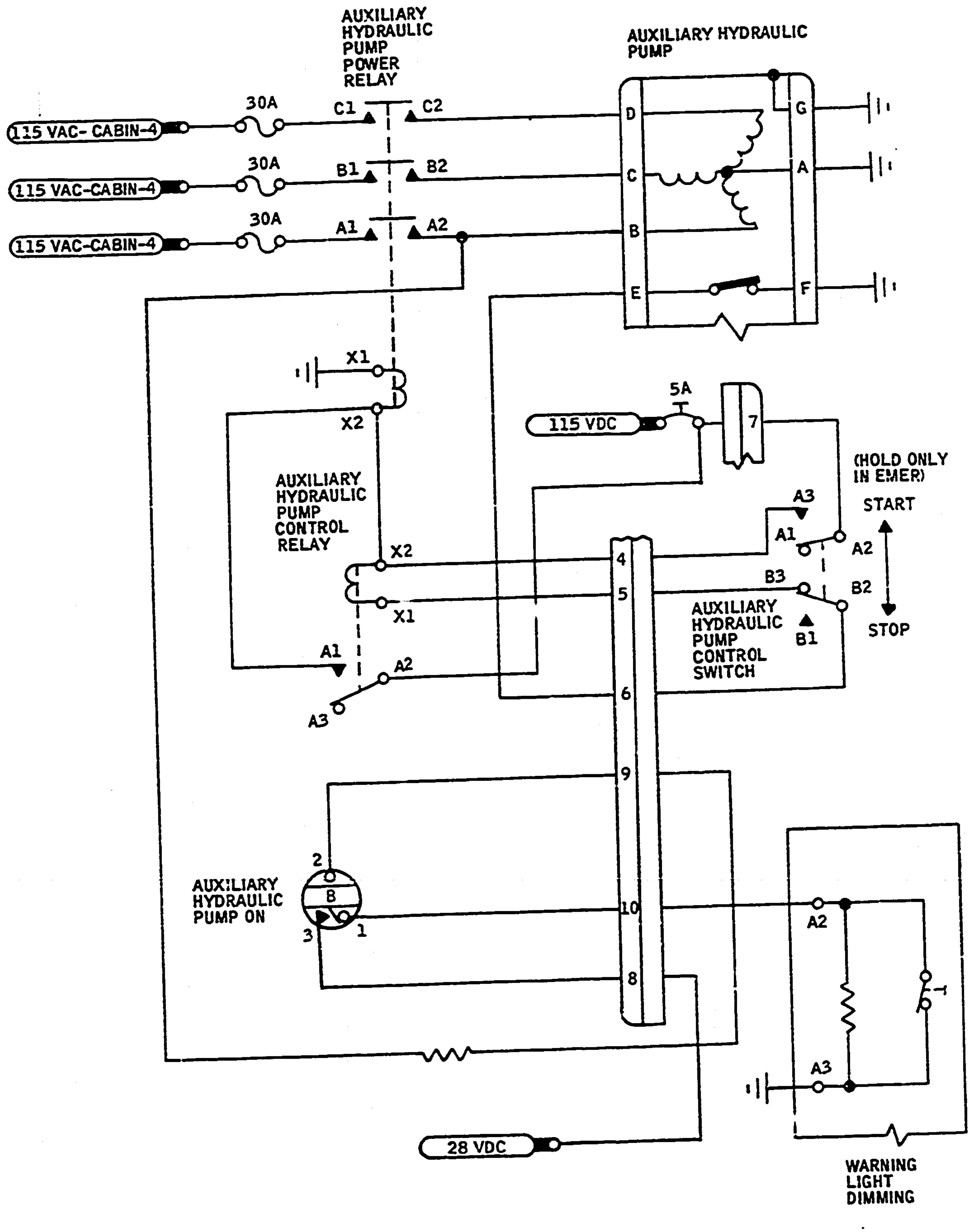


HA2-5742

Auxiliary Hydraulic Pump Control System -- Schematic
(Airplanes 816 - 819)
Figure 1 (Sheet 2)



HA2-5743

Auxiliary Hydraulic Pump Control System -- Schematic
(Airplanes 801-811, 820-822, 860 and Subsequent)
Figure 1 (Sheet 3)

AUXILIARY HYDRAULIC PUMP BYPASS LINE FILTER -

MAINTENANCE PRACTICES

1. General

   A. The auxiliary hydraulic pump bypass line filter is located on the alternate reservoir whic is located in the left wing root area just forward of the auxiliary hydraulic pump.

   B. Access to the auxiliary hydraulic pump bypass line filter is through the left wing root access door.

2. Removal/Installation Auxiliary Hydraulic Pump Bypass Line Filter

   A. Remove Bypass Line Filter

      (1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel and hydraulic system over-temperature rudder and aileron manual indicator circuit breaker located on dc bus 4 section of EPC circuit breaker panel.

      WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Place hydraulic system selector control lever in general system (normal) position.

      (3) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (4) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (5) Drain auxiliary hydraulic pump alternate reservoir to a point below side port where filter is mounted (see 29-00, Maintenance Practices).

      (6) Install magnetic drain plug in manifold at bottom of reservoir. Tighten to torque of 312 (±20) inch-pounds. Safety with lockwire.

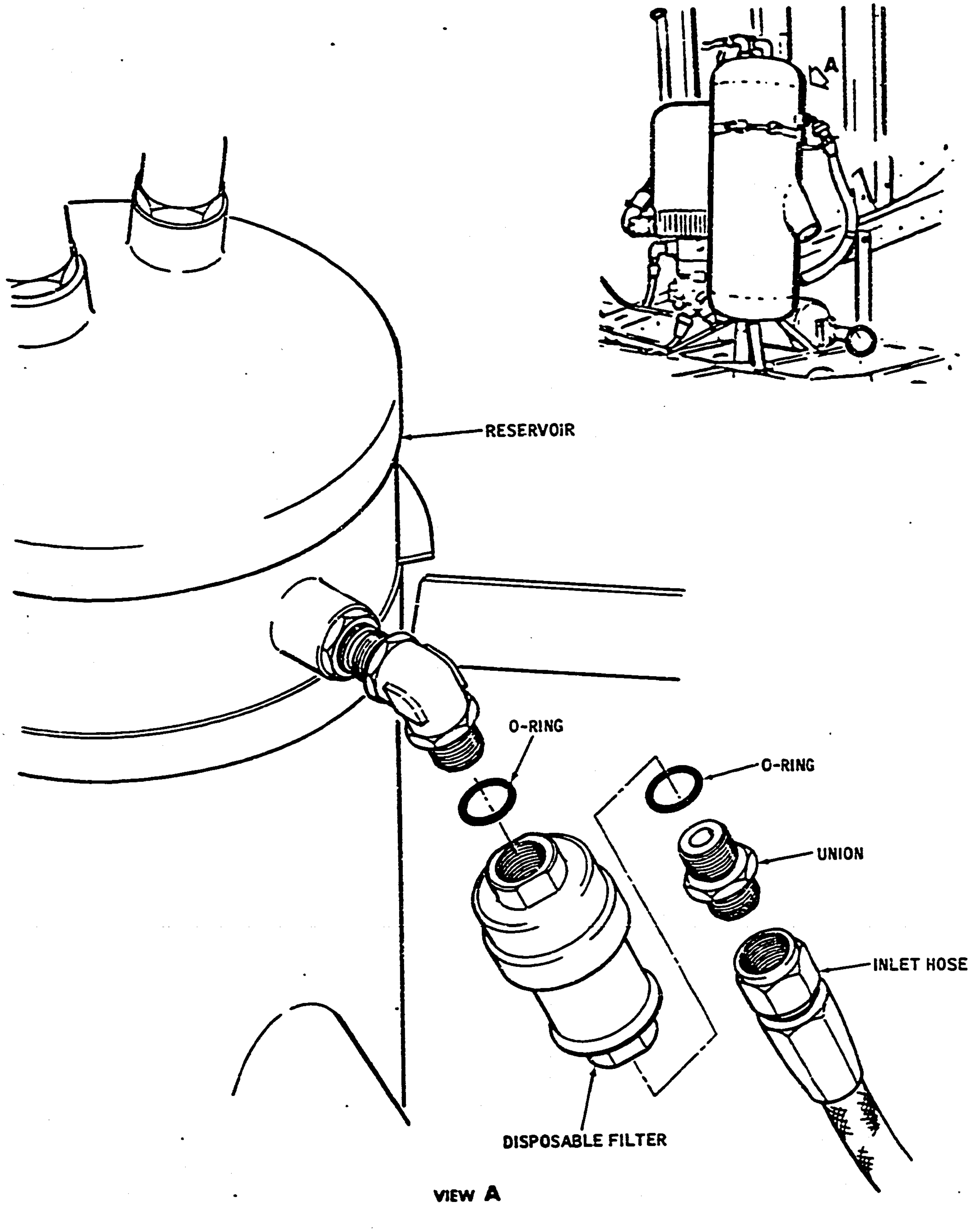
      (7) Disconnect auxiliary pump bypass line at bottom of filter.

      (8) Remove filter from elbow fitting in reservoir side port.

   B. Install Bypass Line Filter

      (1) Make certain that auxiliary hydraulic pump control and hydraulic system overtemperature rudder and aileron manual indicator circuit breakers are open.

      (2) Install filter on elbow fitting in reservoir side port.



Auxiliary Hydraulic Pump Bypass
Line Filter -- Installation
Figure 201

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(3) Connect bypass line to bottom of filter.

(4) Close auxiliary hydraulic pump control and hydraulic overtemperature rudder and aileron manual indicator circuit breakers.

(5) Fill auxiliary hydraulic pump alternate reservoir (see 29-20-8, Servicing).

3. Inspection/Check Auxiliary Hydraulic Pump Bypass Line Filter

A. Check Bypass Line Filter

(1) Make certain that hydraulic system selector control lever is in general system (normal) position.

(2) Pressurize hydraulic system with auxiliary hydraulic pump (see 29-00, Maintenance Practices).

WARNING: MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN THE DOWN POSITION AND THE LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Check that hydraulic fluid is visible in alternate reservoir sight gage.

(4) Check hydraulic fittings on reservoir and bypass line filter for leaks.

(5) Check all hydraulic lines in area for security of attachment and general condition.

(6) Check magnetic drain plug on reservoir for safety lockwire.

(7) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(8) Fill hydraulic system reservoir as described on instruction placard on reservoir.

INDICATING - DESCRIPTION AND OPERATION

1. General

A. Description

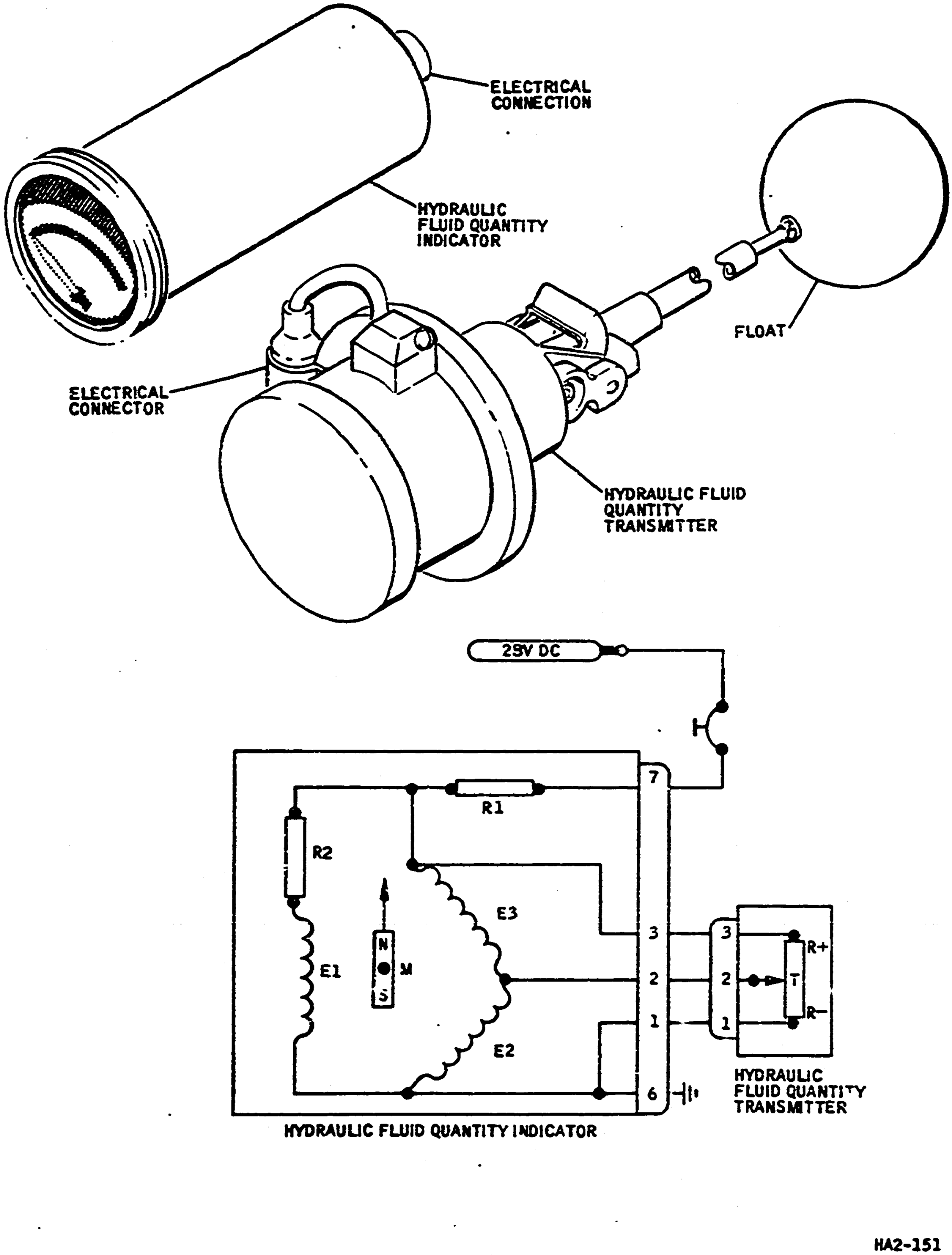
(1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and three (hydraulic reservoir low pressure, hydraulic fluid overtemperature, and emergency reservoir fluid level) are presented by indicating lights.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangement, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the R+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposite effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent magnet (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coils proportionately, therefore affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.



Hydraulic Fluid Quantity Indicating System -- Schematic
Figure 1

3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system is the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb, installed in the reservoir, and an indicator in the flight compartment.

B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanent magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

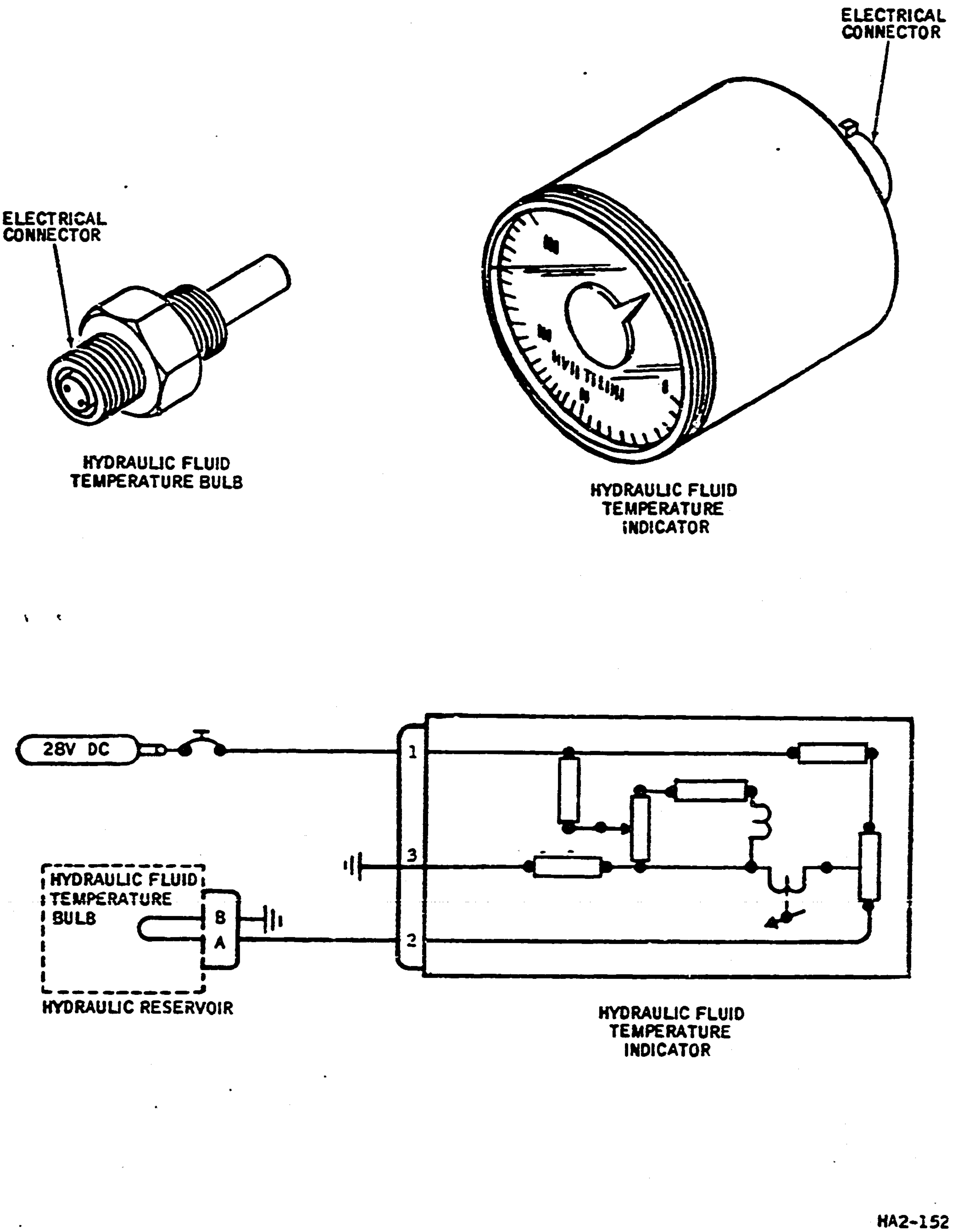
A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter [illegible] transmitter is located in the upper right side of the nosewheel [illegible] and is connected by tubing to the hydraulic system pressure lines.

B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 28-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

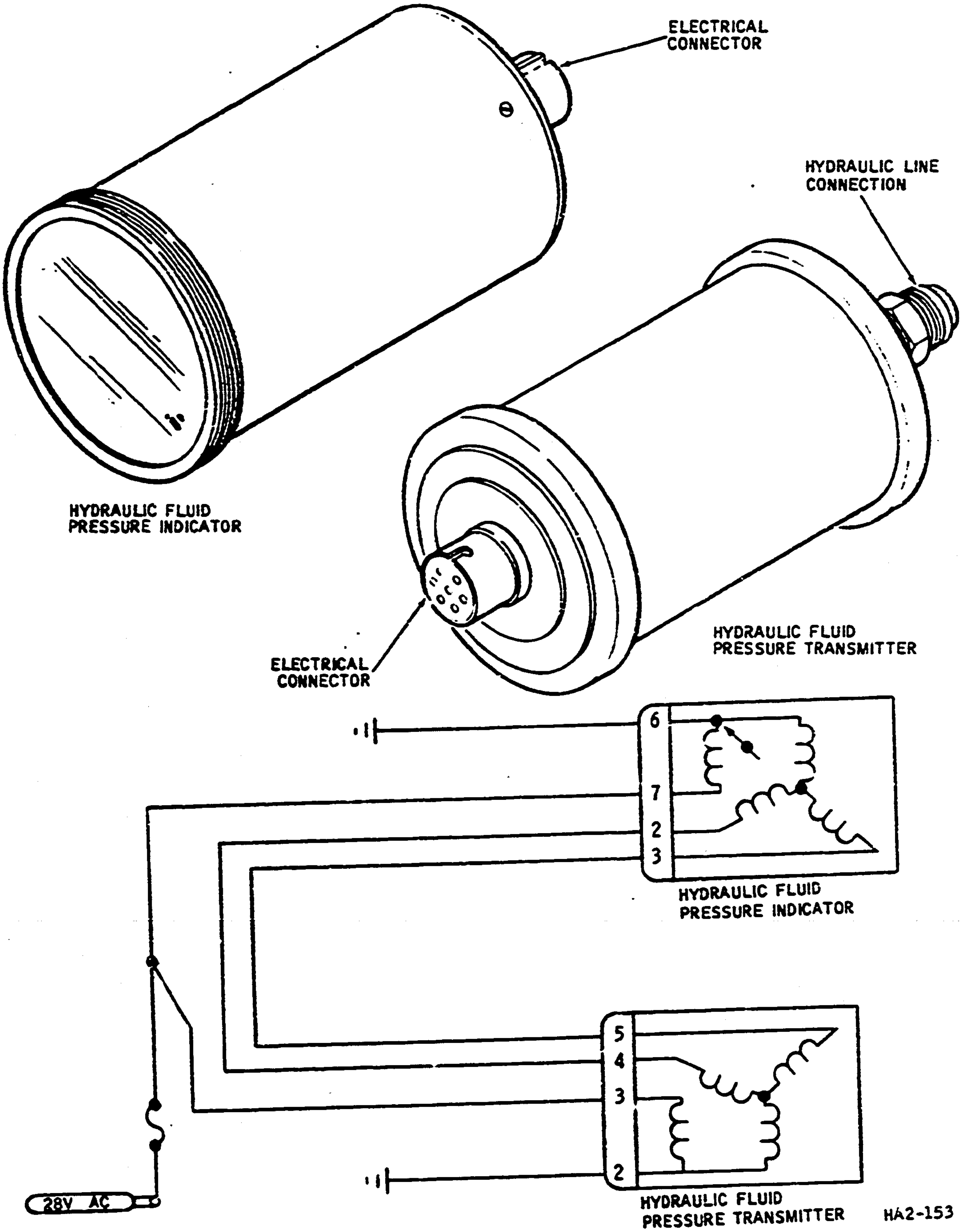
C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.

5. Hydraulic Reservoir Low-Pressure Indicating Light System (See Figure 4.)

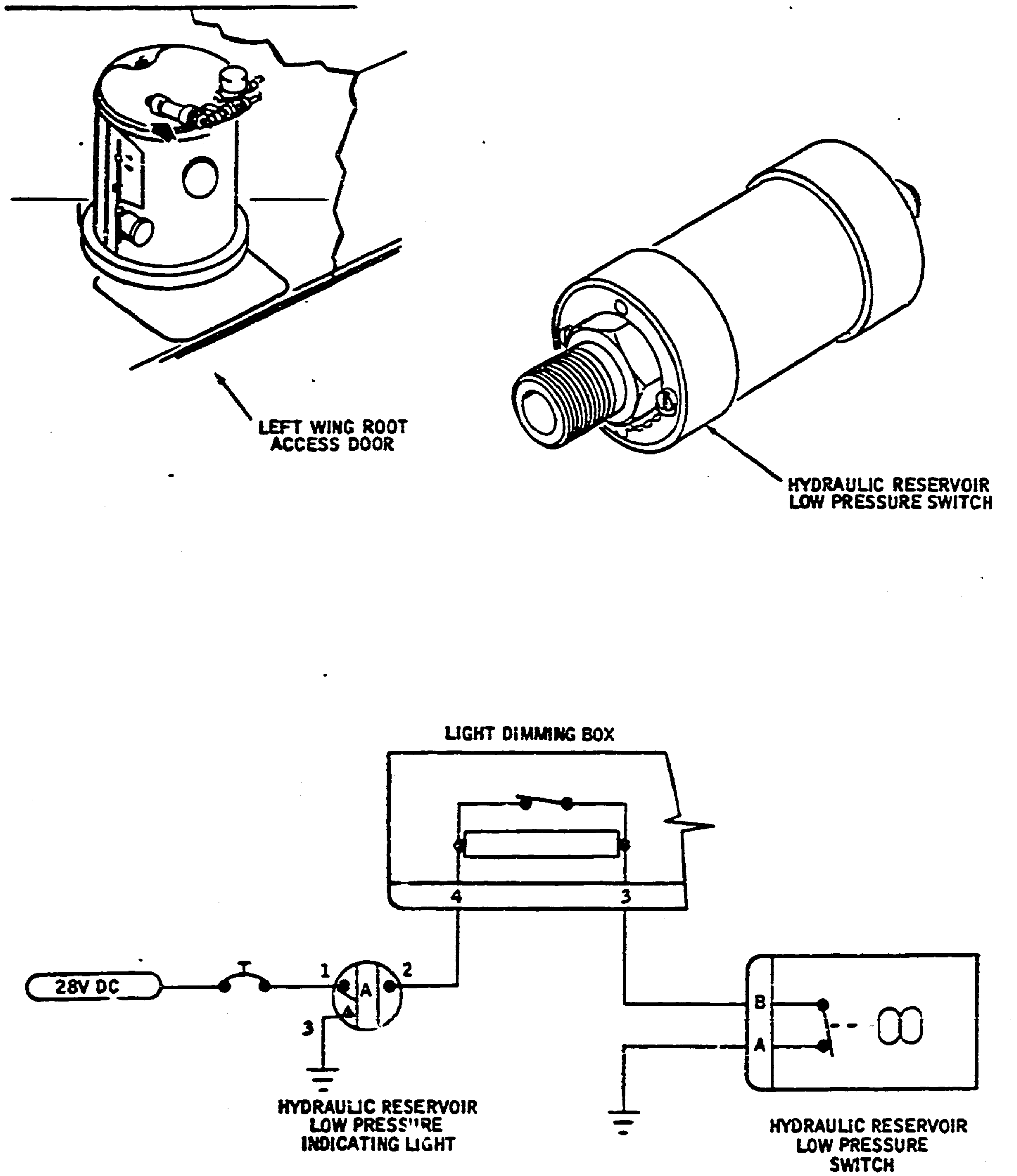
A. The hydraulic reservoir low-pressure indicating light system provides a visual indication of below normal air pressure in the hydraulic reservoir. The system consists of a pressure-actuated switch located on the hydraulic



Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2



Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3



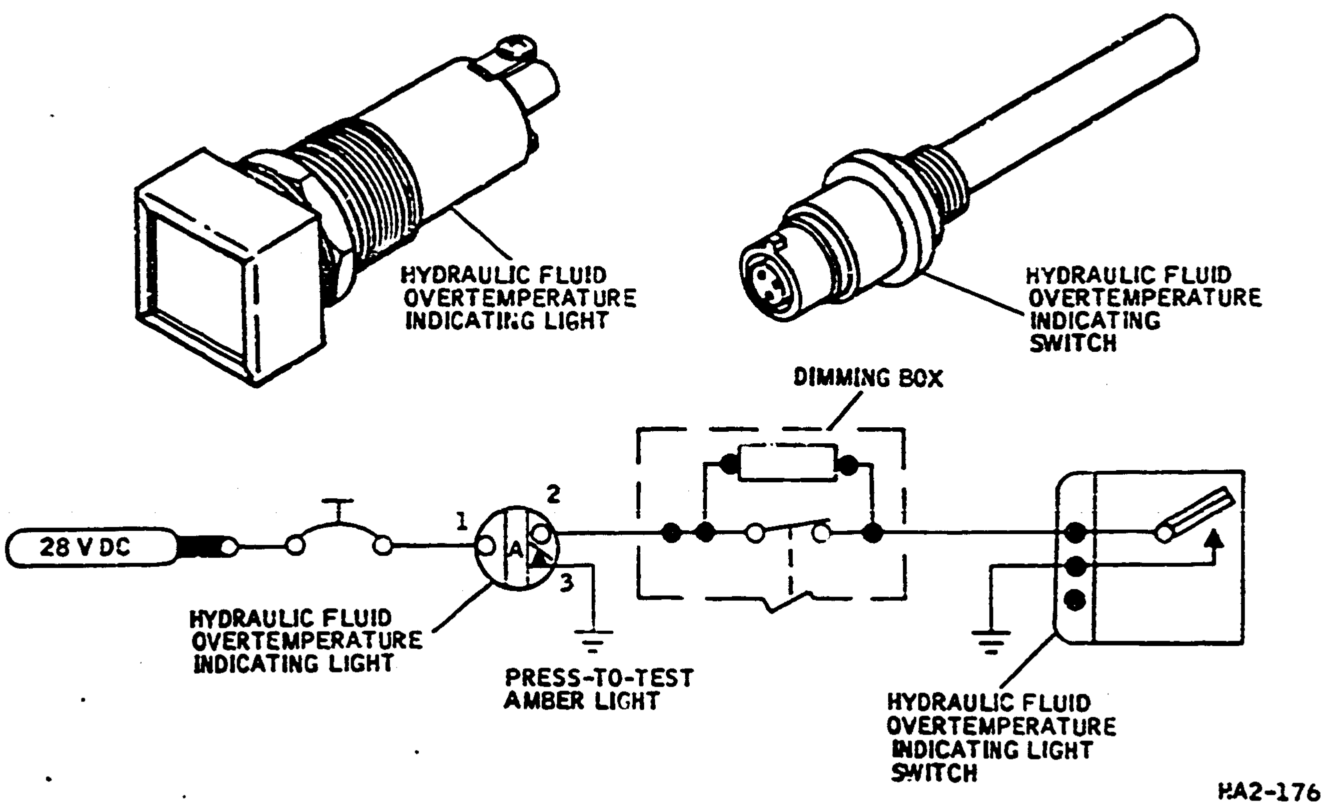
HA2-202

Hydraulic Reservoir Low-Pressure Indicating
Light System -- Schematic
Figure 4

reservoir, a light-dimming switch and resistor, and a press-to-test amber indicator light in the flight compartment. The hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 25 (±2) psi and goes off when the pressure reaches 30 (±2) psi.

6. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 5.)

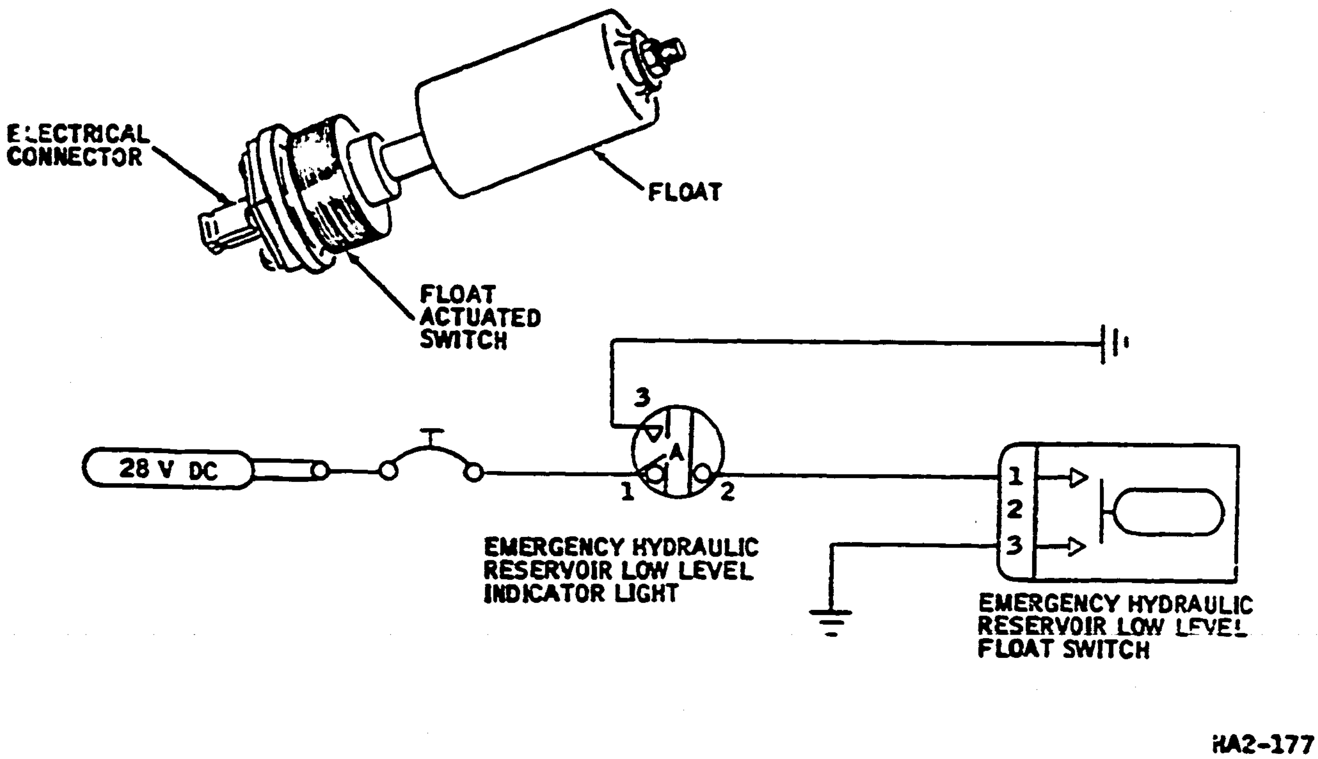
A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an over-temperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°F).



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 5

7. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 6.)

A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.



Emergency Hydraulic Reservoir Low Level Indicating System -- Schematic
Figure 6

INDICATING - DESCRIPTION AND OPERATION

1. General

A. Description

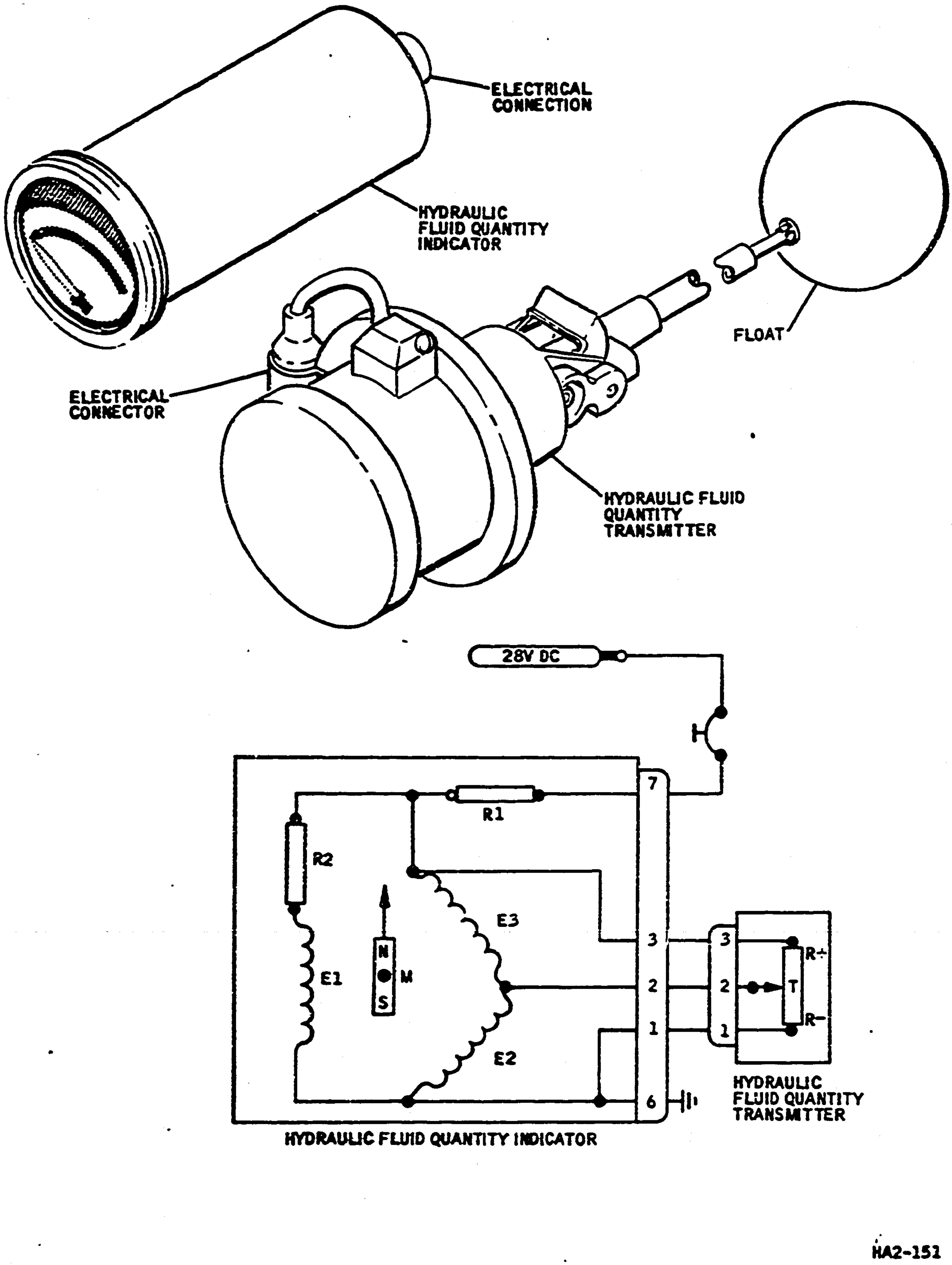
(1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and four (hydraulic reservoir low pressure, hydraulic fluid overtemperature, emergency reservoir fluid level, and hydraulic pump low pressure) are presented by indicating lights.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangement, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the indicator rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the R+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposite effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent magnet (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coils proportionately, therefore affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.



Hydraulic Fluid Quantity Indicating System -- Schematic
Figure 1

3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system is the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb, installed in the reservoir, and an indicator in the flight compartment.

B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanant magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

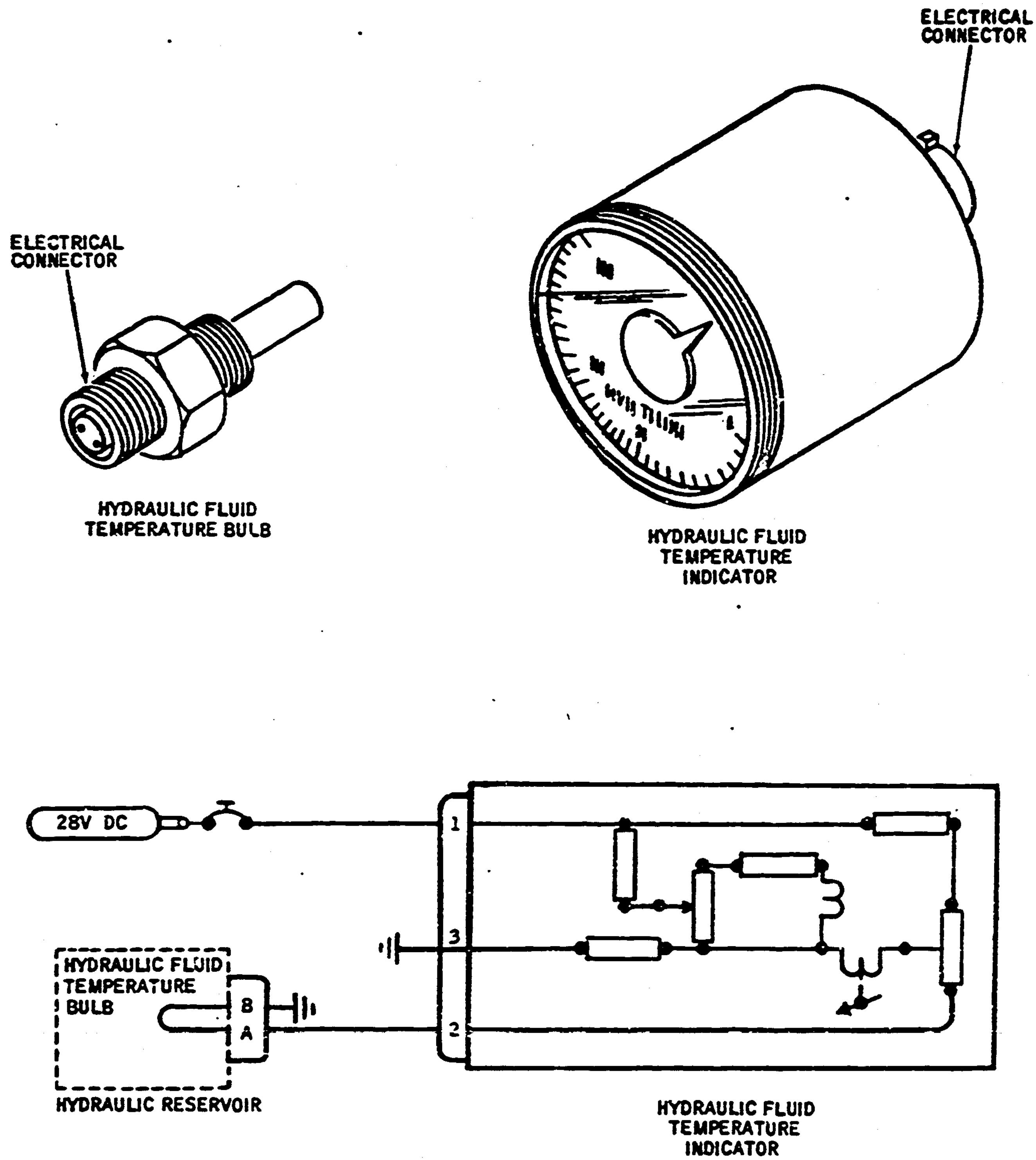
A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter. The transmitter is located in the upper right side of the nosewheel well and is connected by tubing to the hydraulic system pressure lines.

B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 28-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.

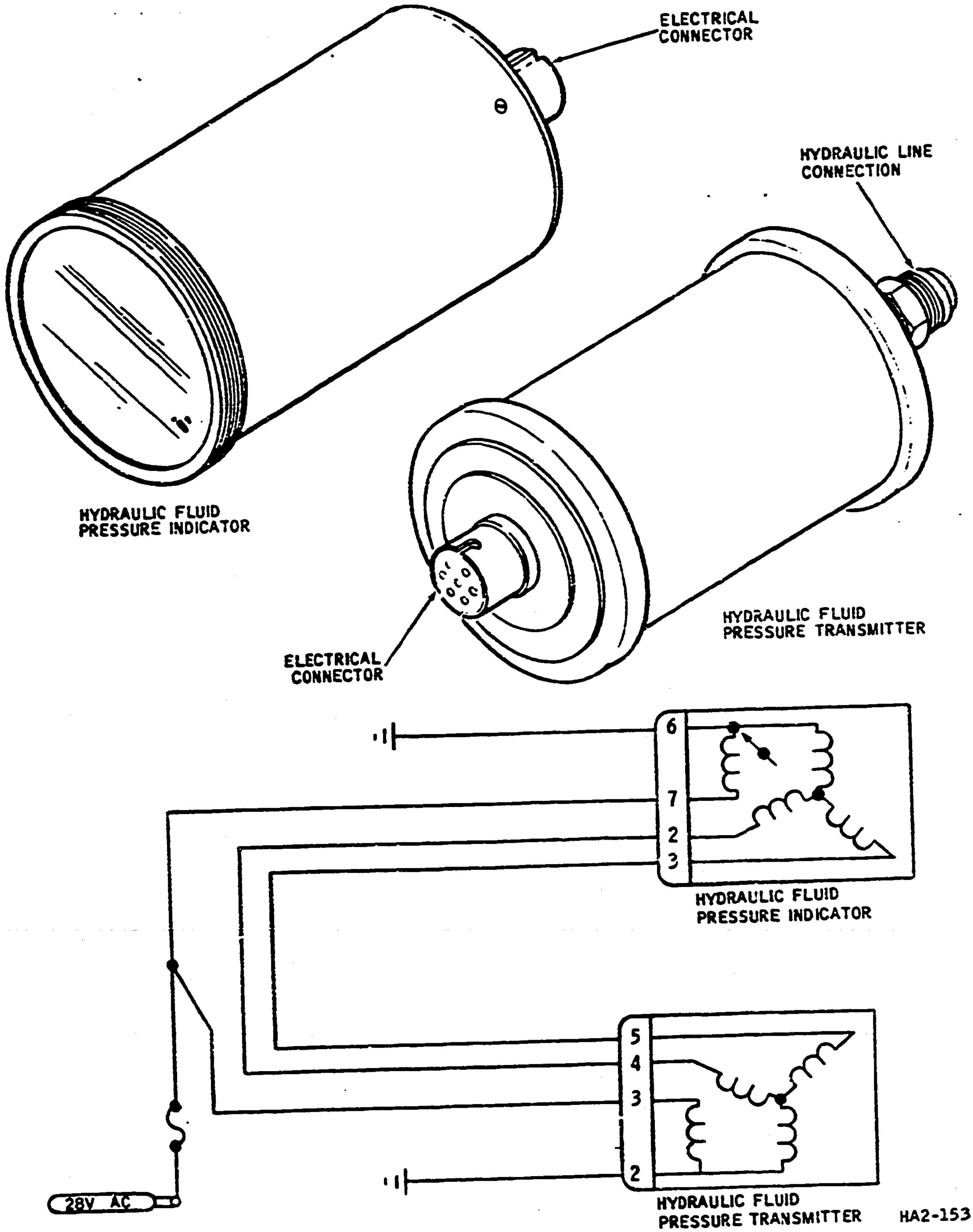
5. Hydraulic Reservoir Low-Pressure Indicating Light System (See Figure 4.)

A. The hydraulic reservoir low-pressure indicating light system provides a visual indication of below normal air pressure in the hydraulic reservoir. The system consists of a pressure-actuated switch located on the hydraulic reservoir, a light-dimming switch and resistor, and a press-to-test amber

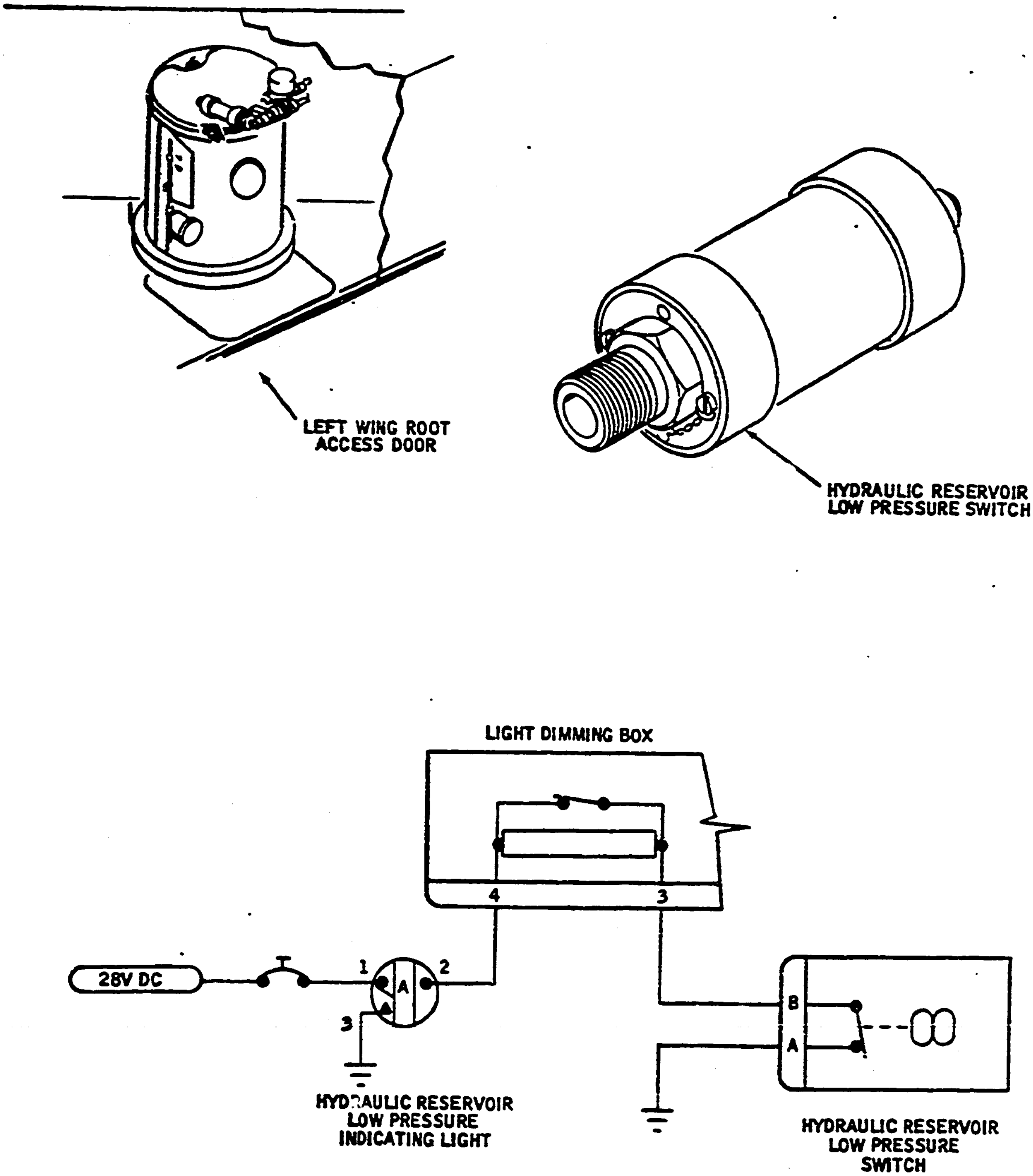


HA2-152

Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2



Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3



HA2-202

Hydraulic Reservoir Low-Pressure Indicating
Light System -- Schematic
Figure 4

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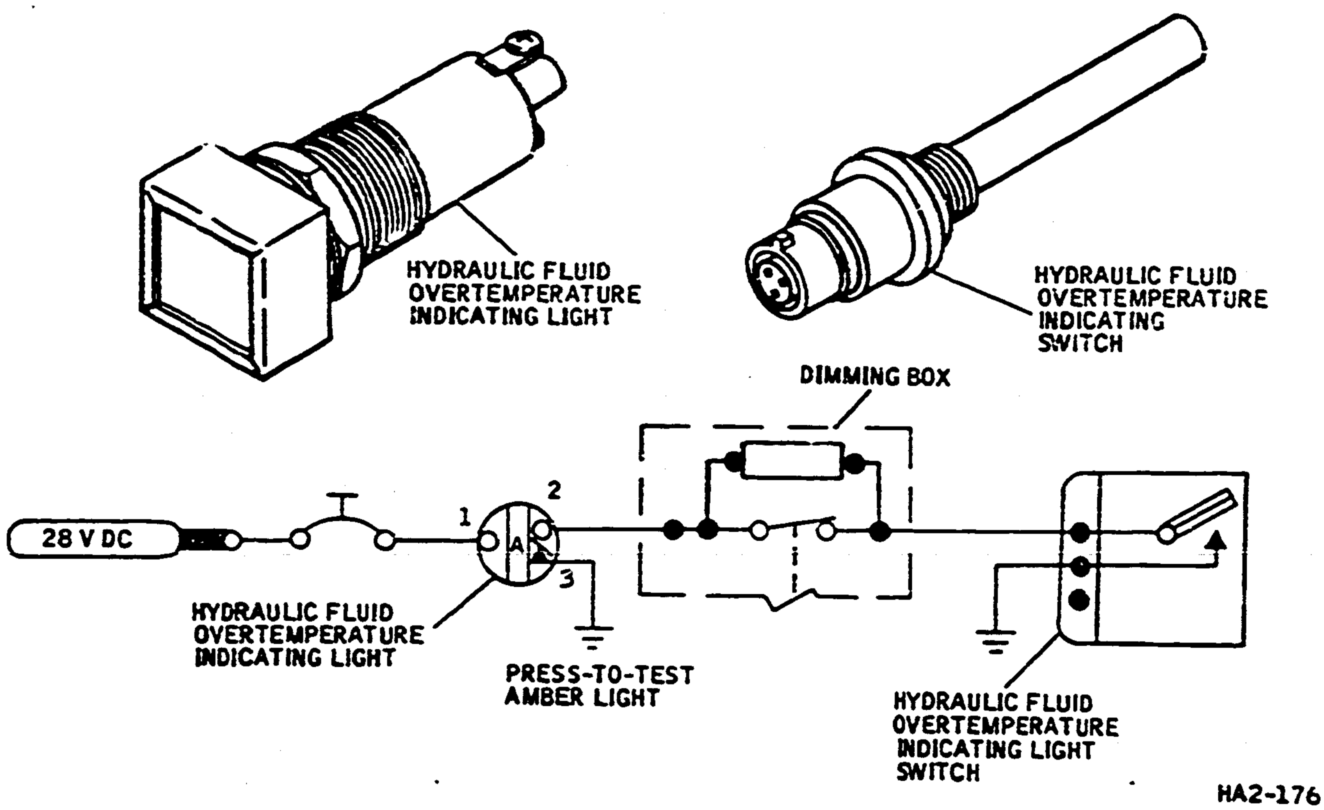
indicator light in the flight compartment. The hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 25 (±2) psi and goes off when the pressure reaches 30 (±2) psi.

6. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 5.)

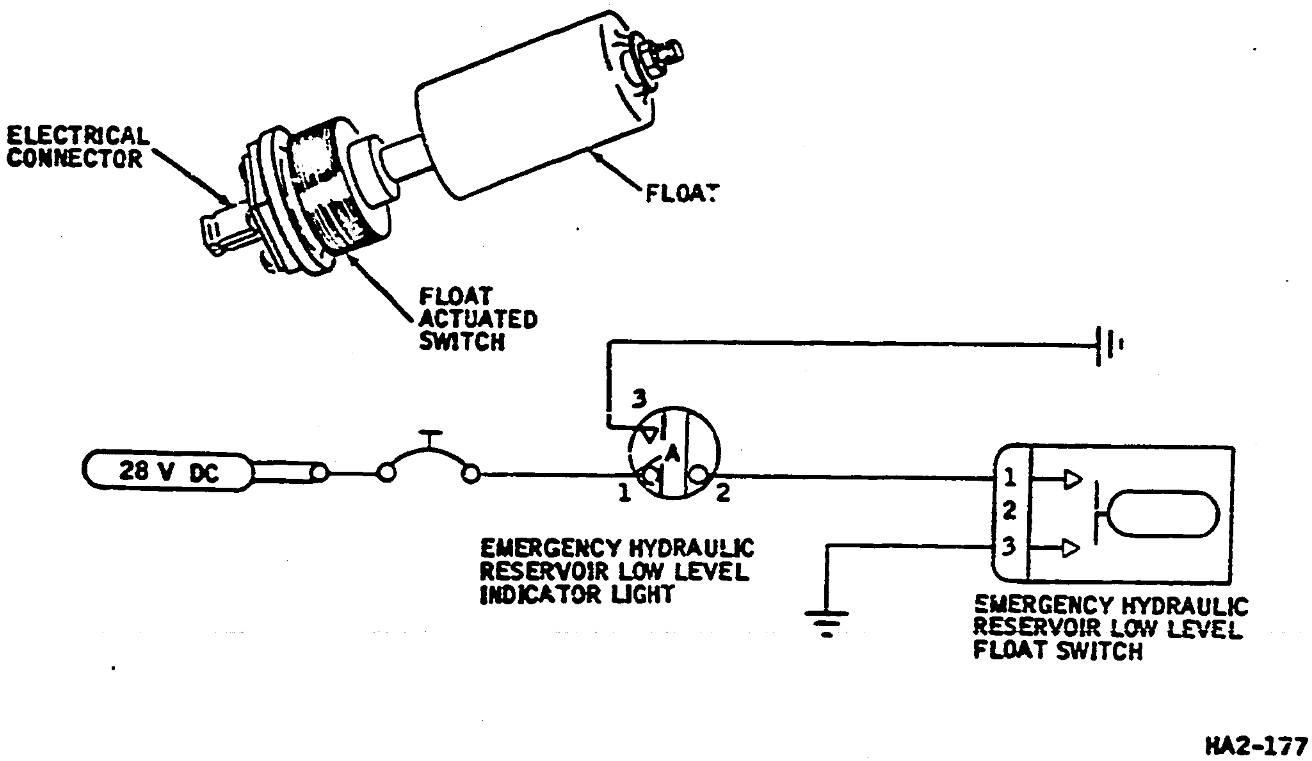
A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an over-temperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°F).



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 5

7. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 6.)

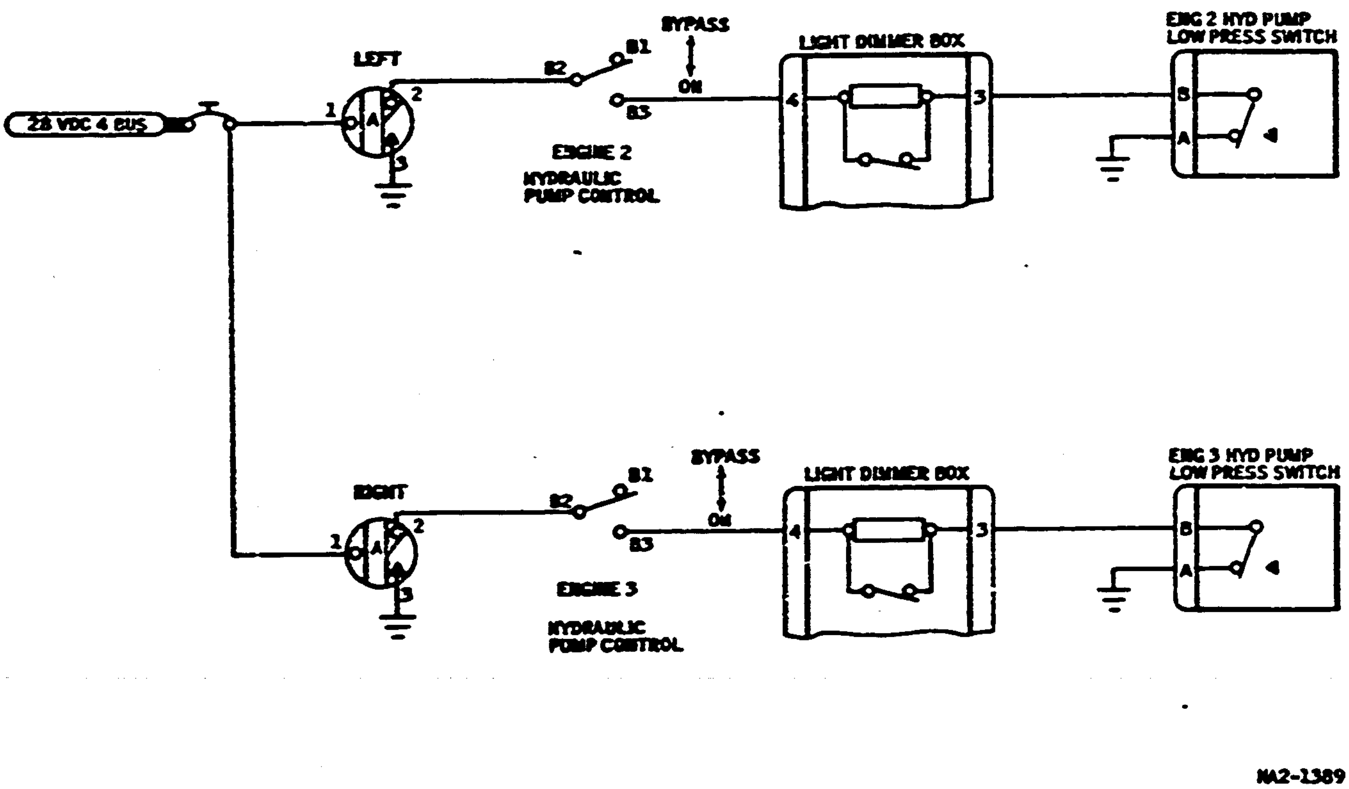
A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.



Emergency Hydraulic Reservoir Low Level
Indicating System -- Schematic
Figure 6

8. Engine-Driven Hydraulic Pump Low Pressure Indicating Light System (See Figure 7.)

A. The engine-driven hydraulic pump low-pressure indicating light system provides a visual indication of low-pressure at the output of either engine-driven pump. The system consists of two pressure-actuated switches, indicating light dimming boxes, and two press-to-test amber indicating lights. One switch is located at each engine-driven pump. The indicating lights are located in the flight compartment. When either of the engine-driven hydraulic pump bypass switches is in the on position, the corresponding engine-driven pump indicating light comes on if the output pressure of the corresponding pump drops below 1500 (±100) psig.



Engine-Driven Hydraulic Pump Low Pressure
Indicating Light System -- Schematic
Figure 7

INDICATING - DESCRIPTION AND OPERATION

1. General

   A. Description

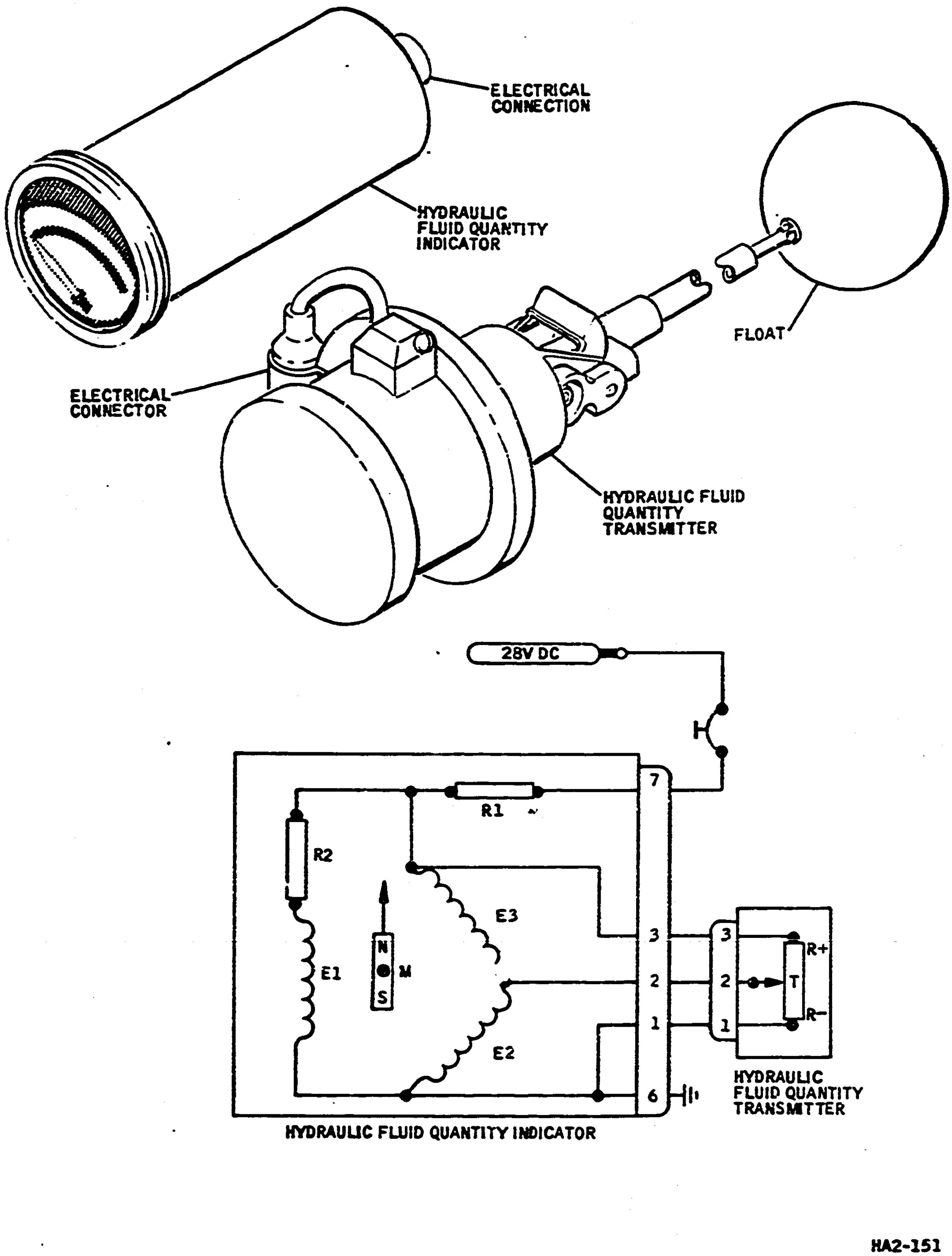
      (1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and two (hydraulic fluid overtemperature and emergency reservoir fluid level) are presented by indicating lights.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

   A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangement, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the indicator rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

   B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

   C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the R+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposite effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent magnet (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coils proportionately, there [illegible] affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.



Hydraulic Fluid Quantity Indicating
System -- Schematic
Figure 1

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3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system is the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb, installed in the reservoir, and an indicator in the flight compartment.

B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanent magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

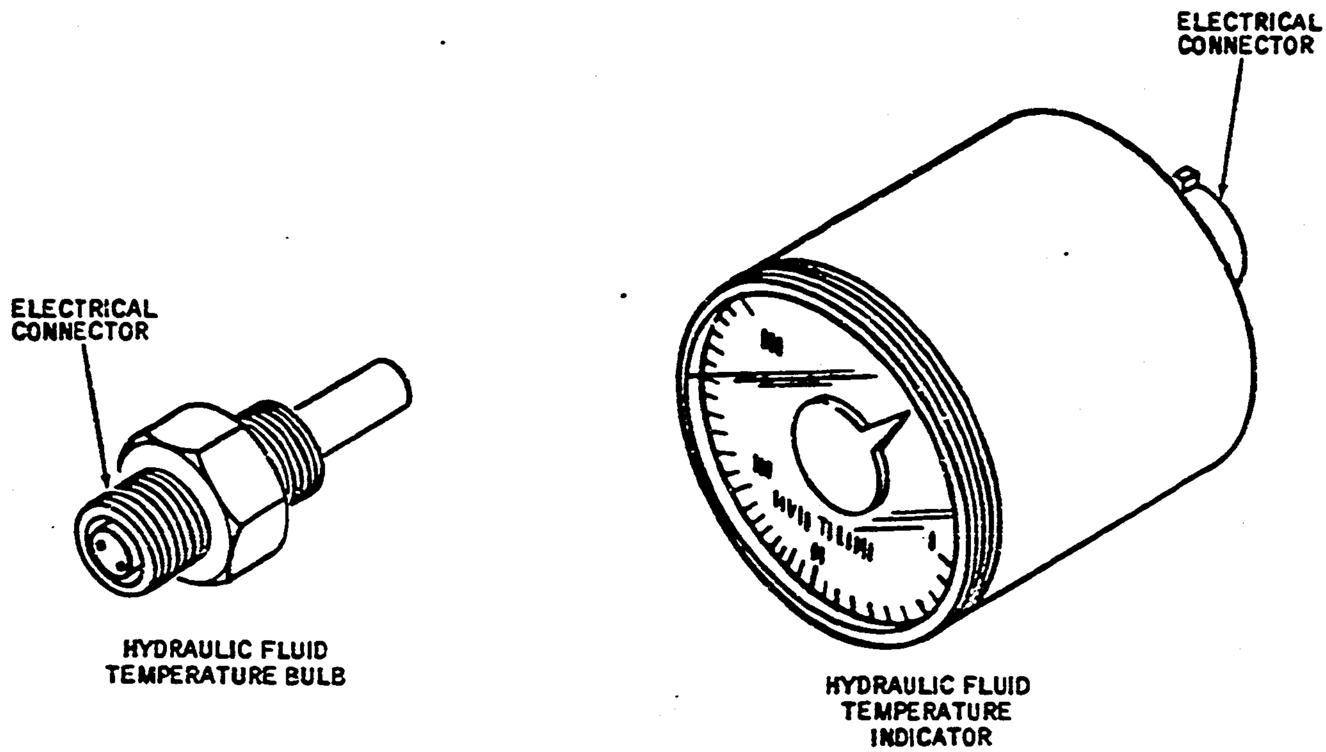
A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter. The transmitter is located in the upper right side of the nosewheel well and is connected by tubing to the hydraulic system pressure lines.

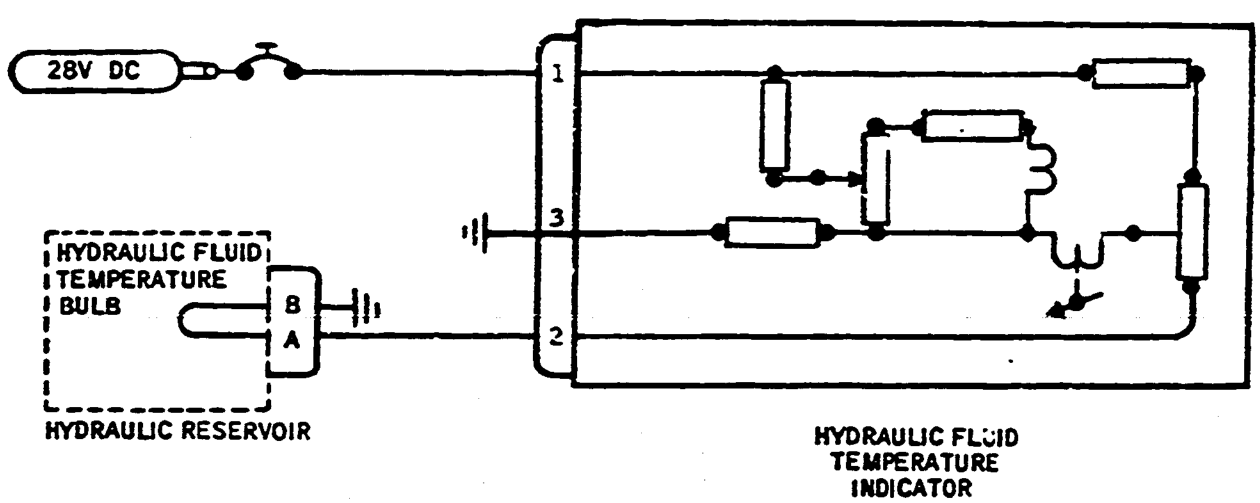
B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 28-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.

5. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 4.)

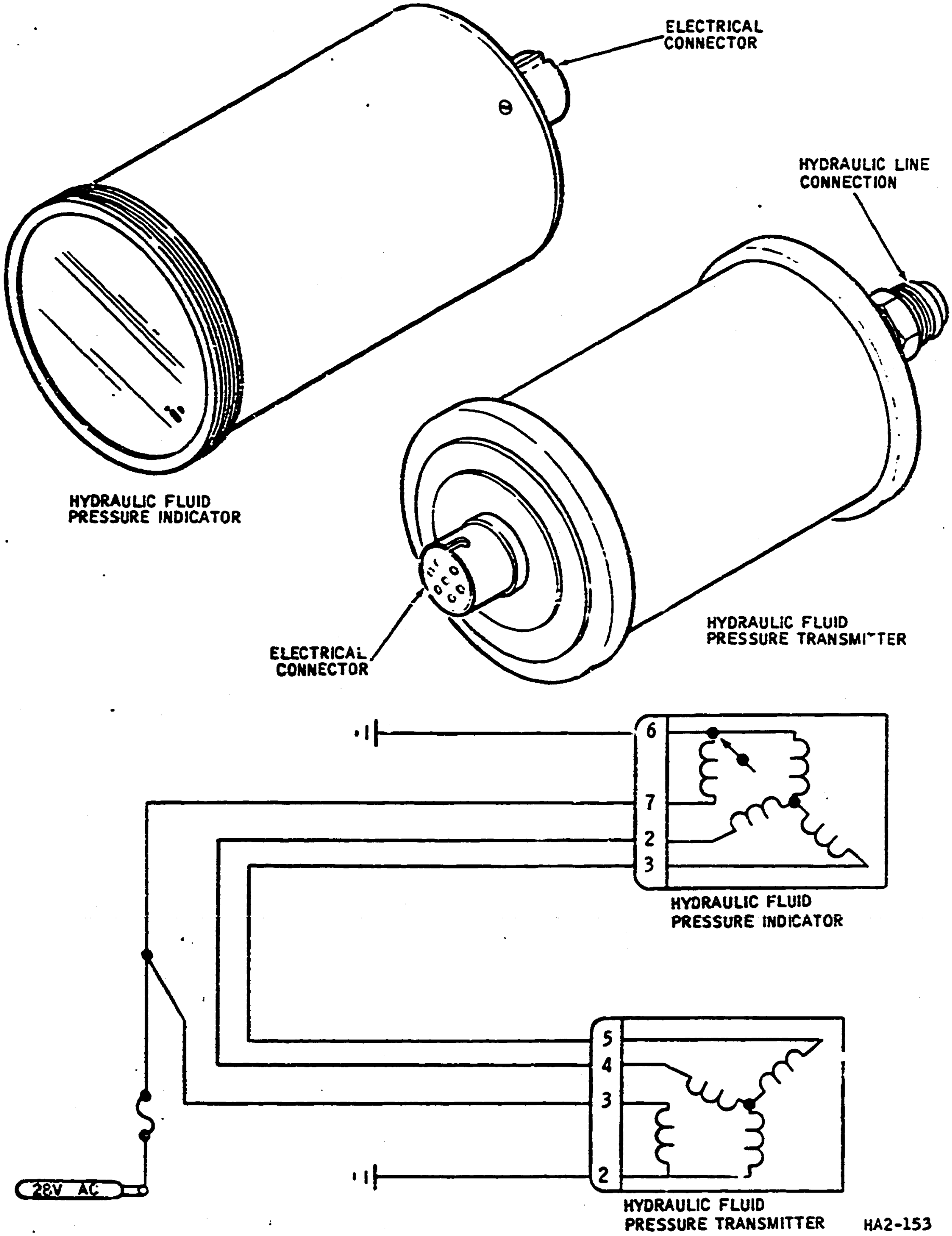
A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The



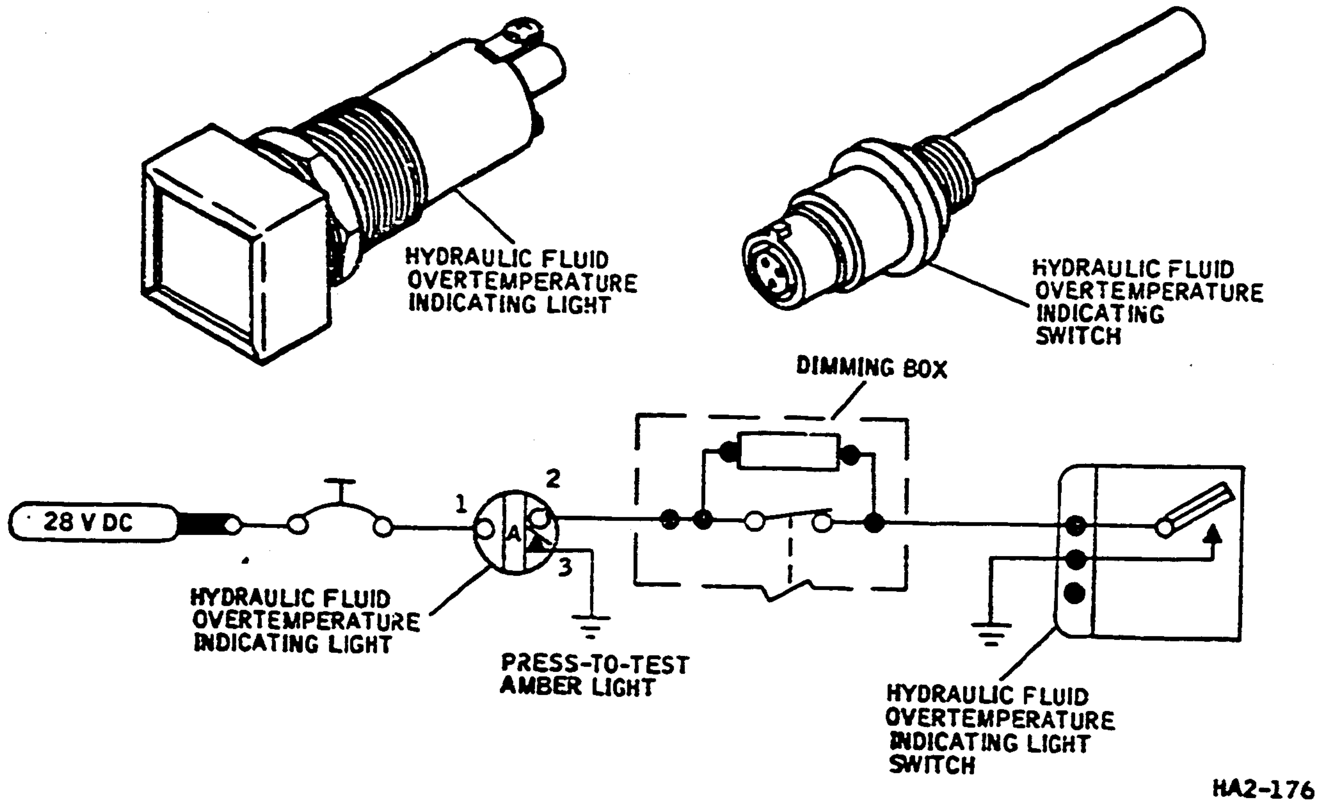


HA2-152

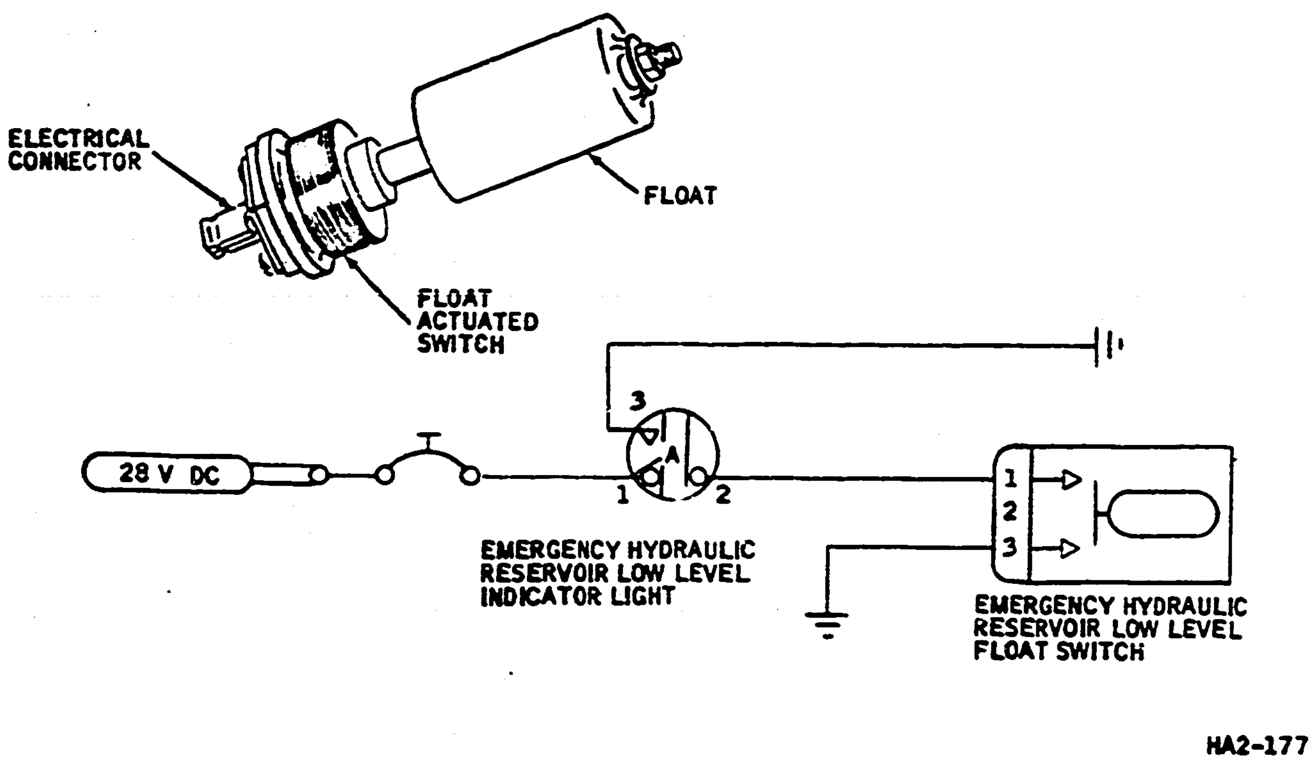
Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2



Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 4



Emergency Hydraulic Reservoir Low Level
Indicating System -- Schematic
Figure 5

system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an over-temperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°F).

6. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 5.)

A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.

INDICATING - DESCRIPTION AND OPERATION

1. General

A. Description

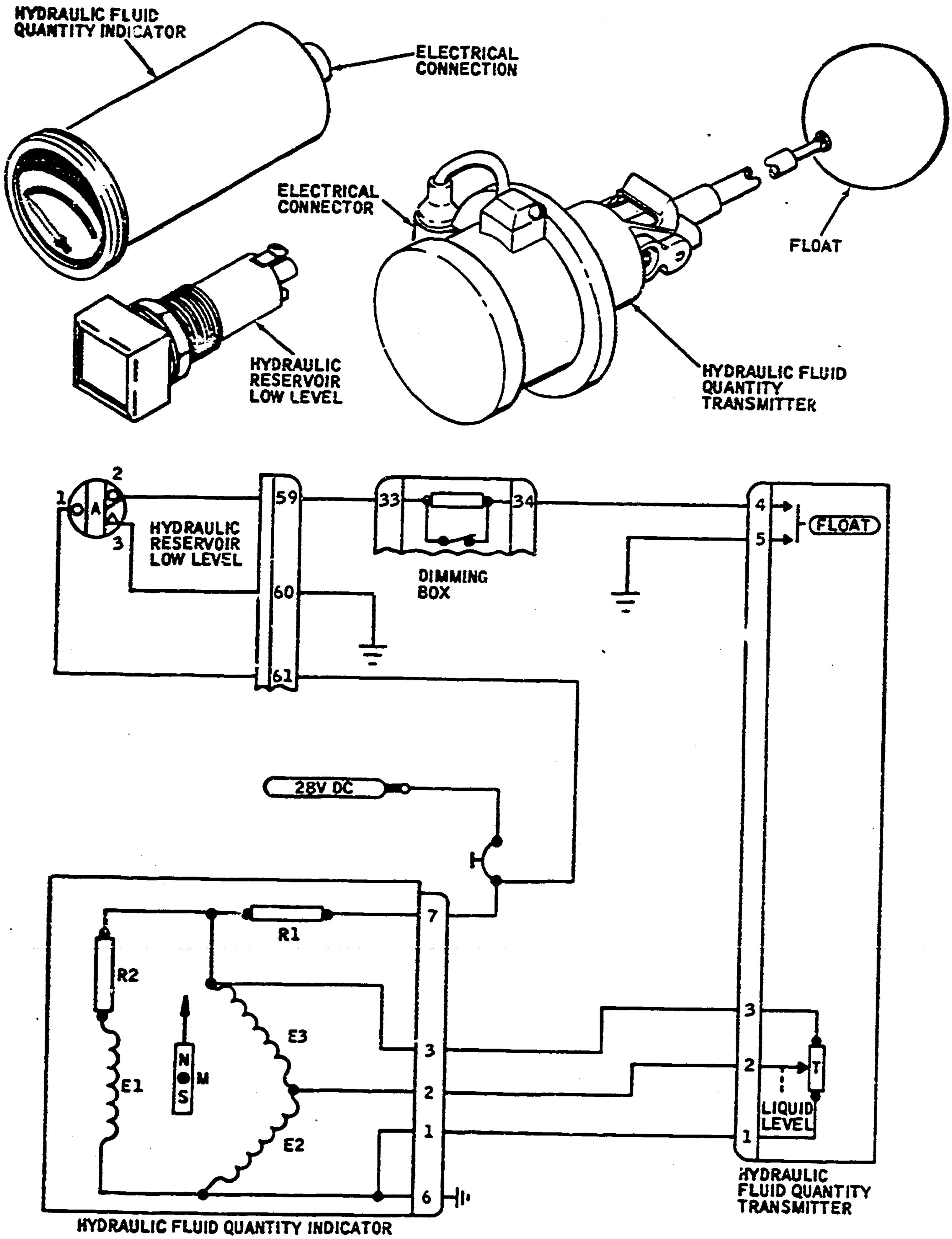
(1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and four (hydraulic reservoir low pressure, hydraulic fluid overtemperature, emergency reservoir fluid level, and hydraulic pump low pressure) are presented by indicating lights.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, a hydraulic reservoir low level indicating light switch, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangement, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the indicator rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the R+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposite effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent magnet (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coils proportionately, therefore



Hydraulic Fluid Quantity Indicating
System -- Schematic
Figure 1

affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.

3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system is the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb, installed in the reservoir, and an indicator in the flight compartment.

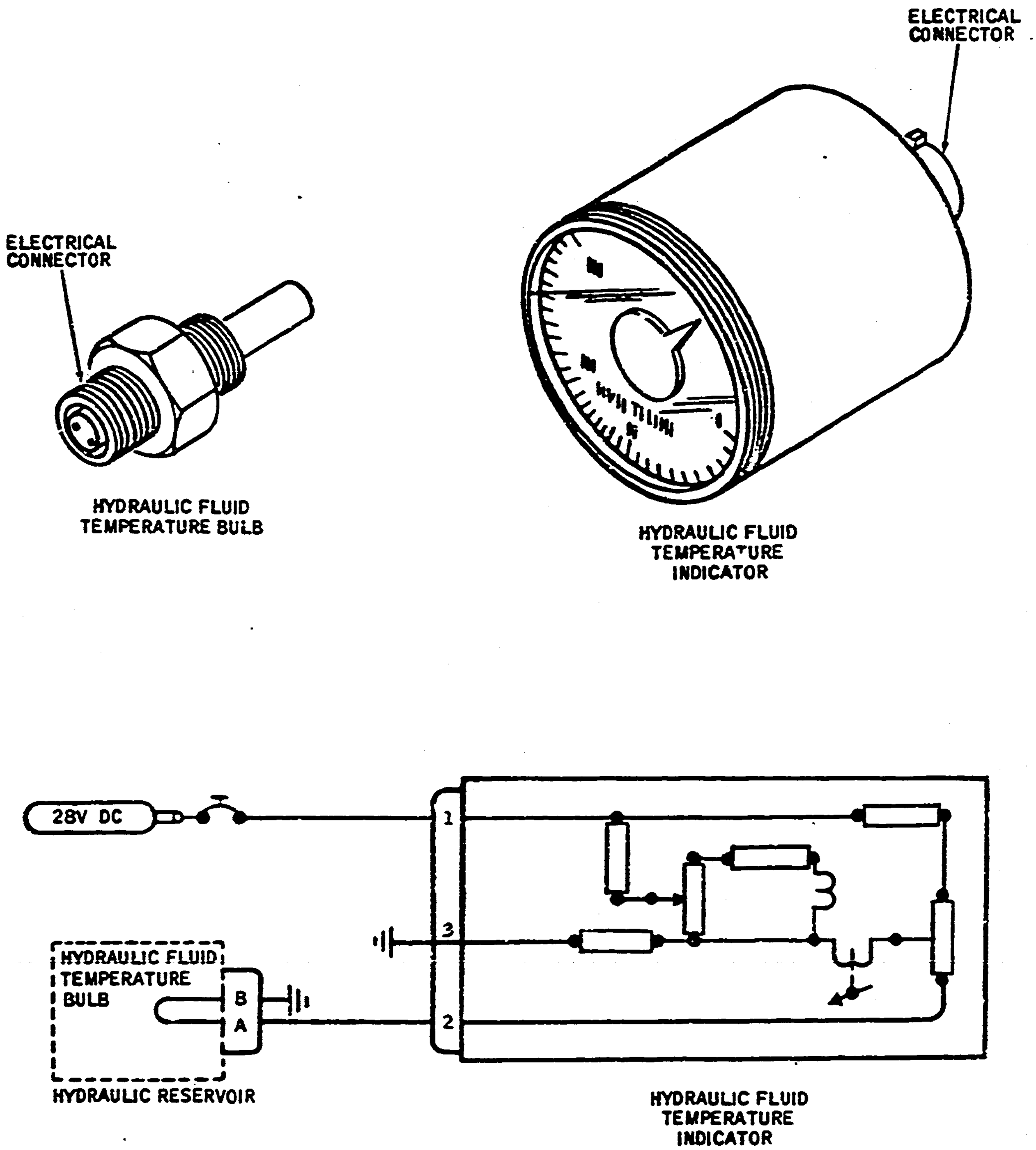
B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanent magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter. The transmitter is located in the upper right side of the nose-wheel well and is connected by tubing to the hydraulic system pressure lines.

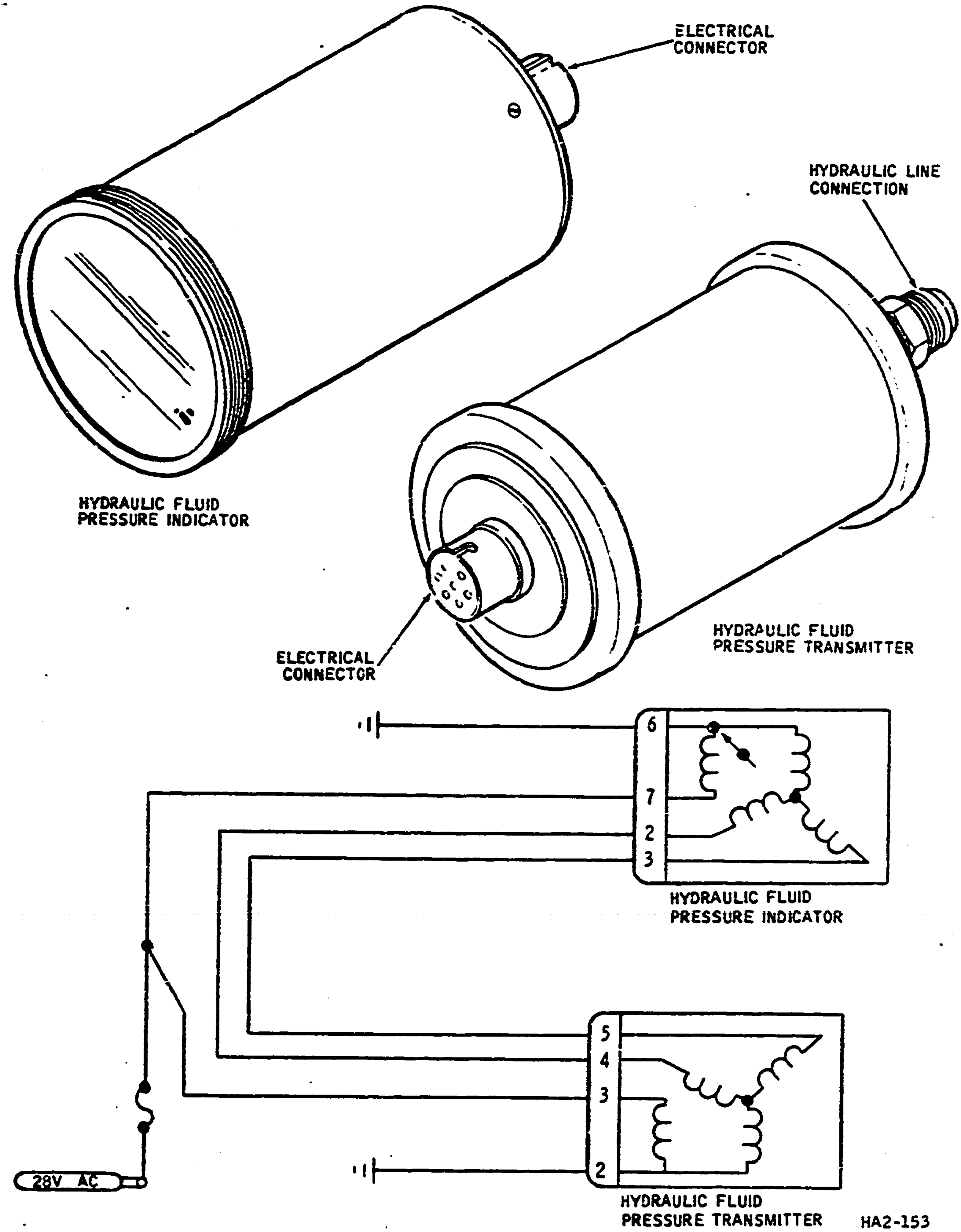
B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 26-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.



HA2-152

Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2



Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3

5. Hydraulic Reservoir Low-Pressure Indicating Light System (See Figure 4.)

A. The hydraulic reservoir low-pressure indicating light system provides a visual indication of below normal air pressure in the hydraulic reservoir. The system consists of a pressure-actuated switch located on the hydraulic reservoir, a light-dimming switch and resistor, and a press-to-test amber indicator light in the flight compartment. The hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 25 (±2) psi and goes off when the pressure reaches 30 (±2) psi.

6. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 5.)

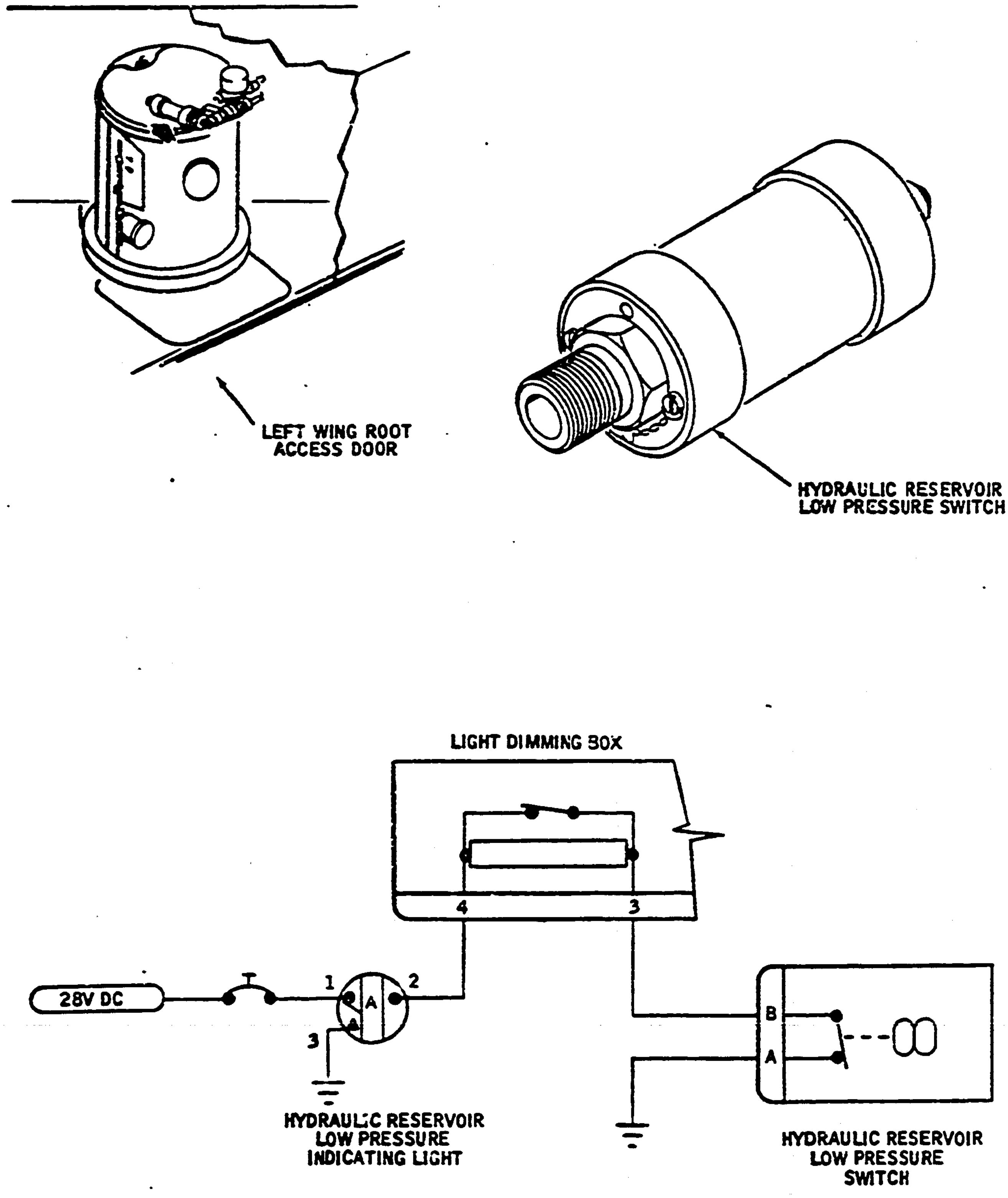
A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an overtemperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°C).

7. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 6.)

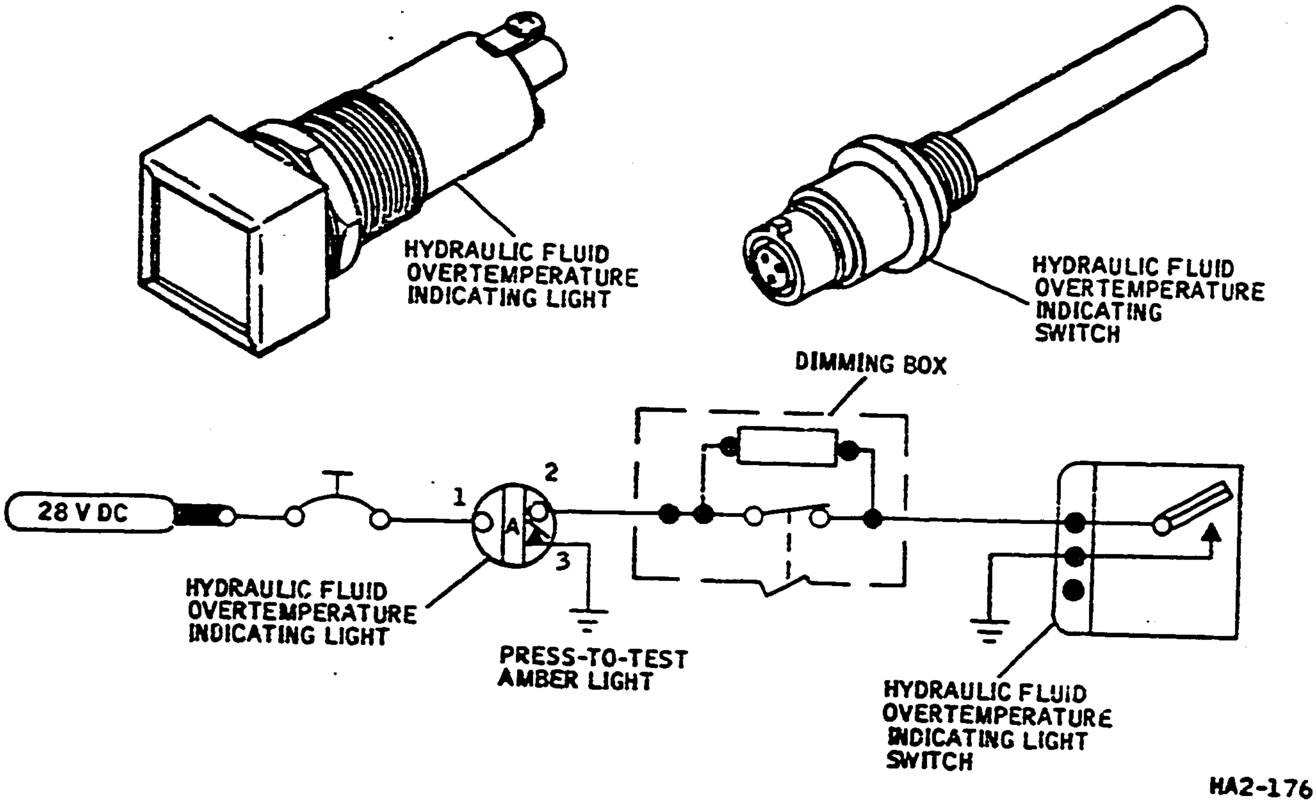
A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.

8. Engine-Driven Hydraulic Pump Low Pressure Indicating Light System (See Figure 7.)

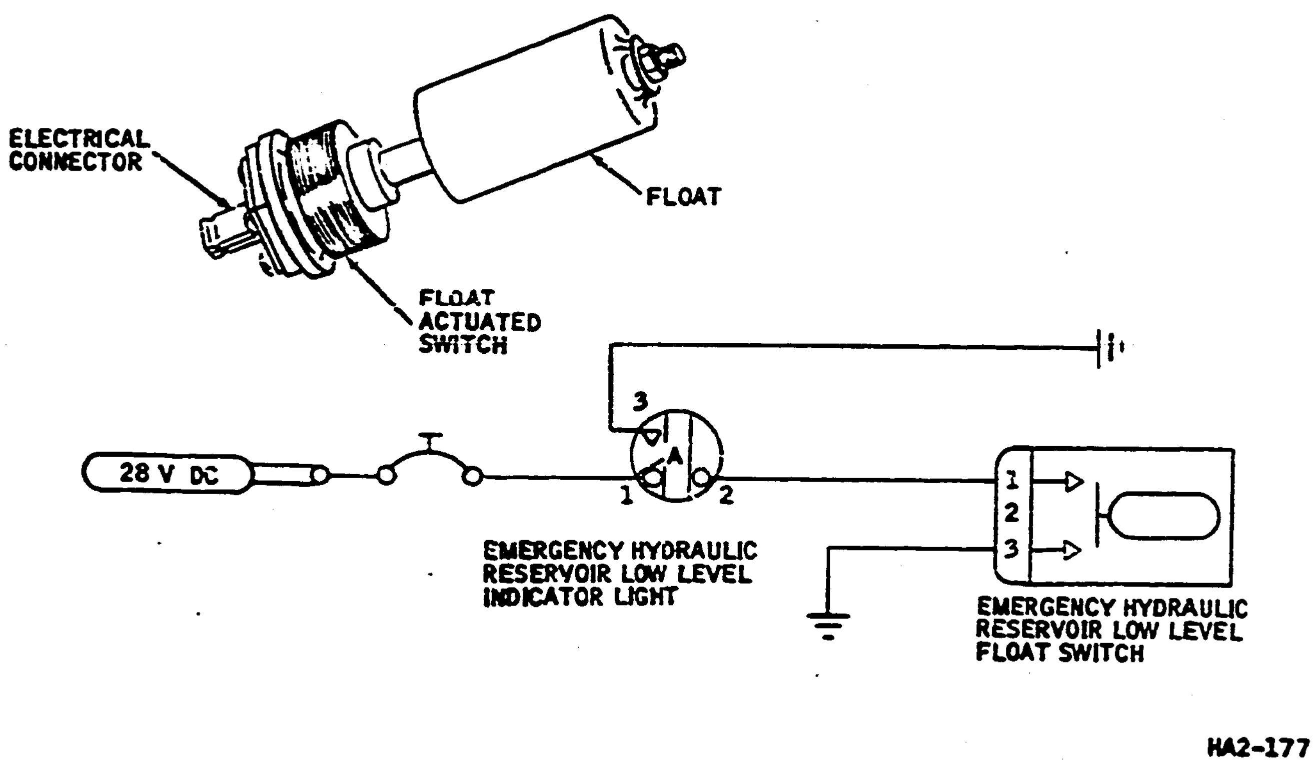
A. The engine-driven hydraulic pump low-pressure indicating light system provides a visual indication of low-pressure at the output of either engine-driven pump. The system consists of two pressure-actuated switches, indicating light dimming boxes, and two press-to-test amber indicating lights. One switch is located at each engine-driven pump. The indicating lights are located in the flight compartment. When either of the engine-driven hydraulic pump bypass switches is in the on position, the corresponding engine-driven pump indicating light comes on if the output pressure of the corresponding pump drops below 1500 (±100) psig.



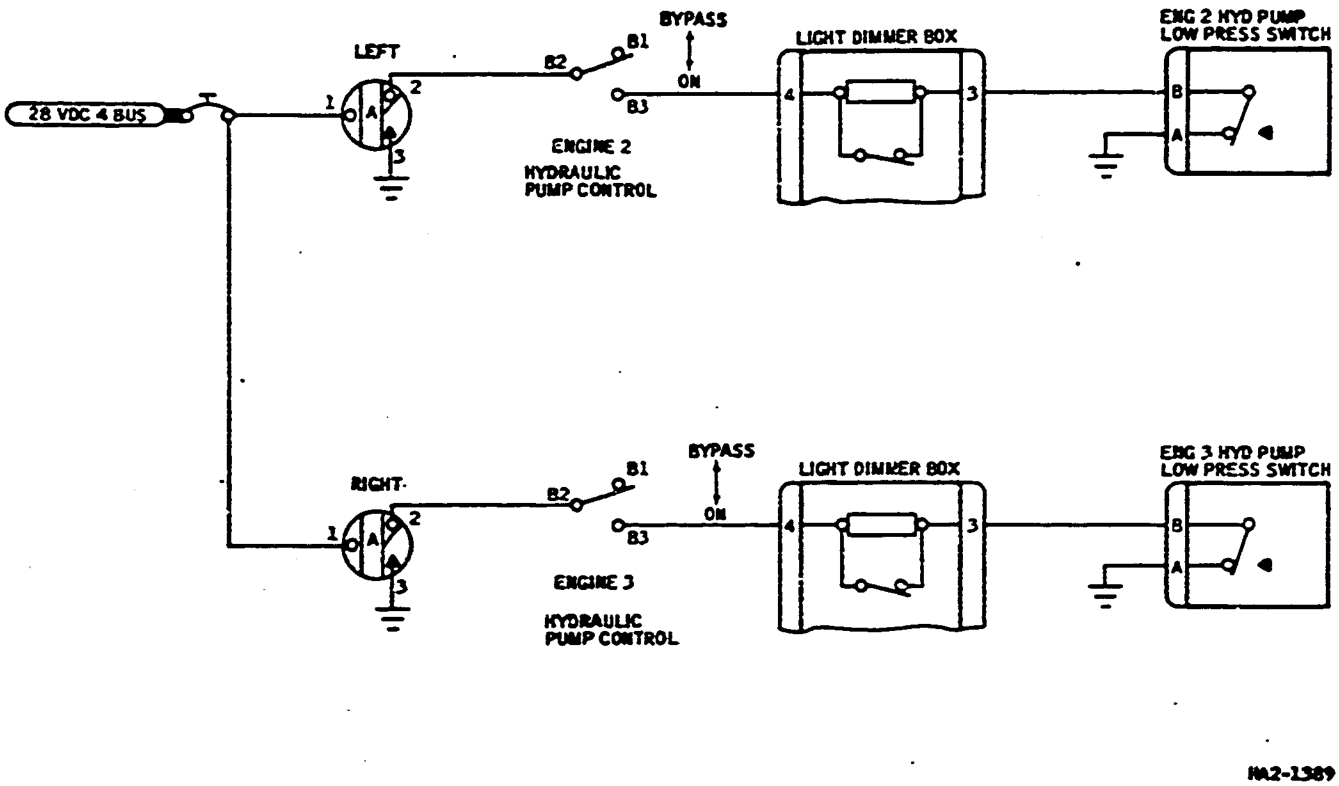
Hydraulic Reservoir Low-Pressure Indicating
Light System -- Schematic
Figure 4



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 5



Emergency Hydraulic Reservoir Low Level
Indicating System -- Schematic
Figure 6



Engine-Driven Hydraulic Pump Low Pressure
Indicating Light System -- Schematic
Figure 7

INDICATING - DESCRIPTION AND OPERATION

1. General

A. Description

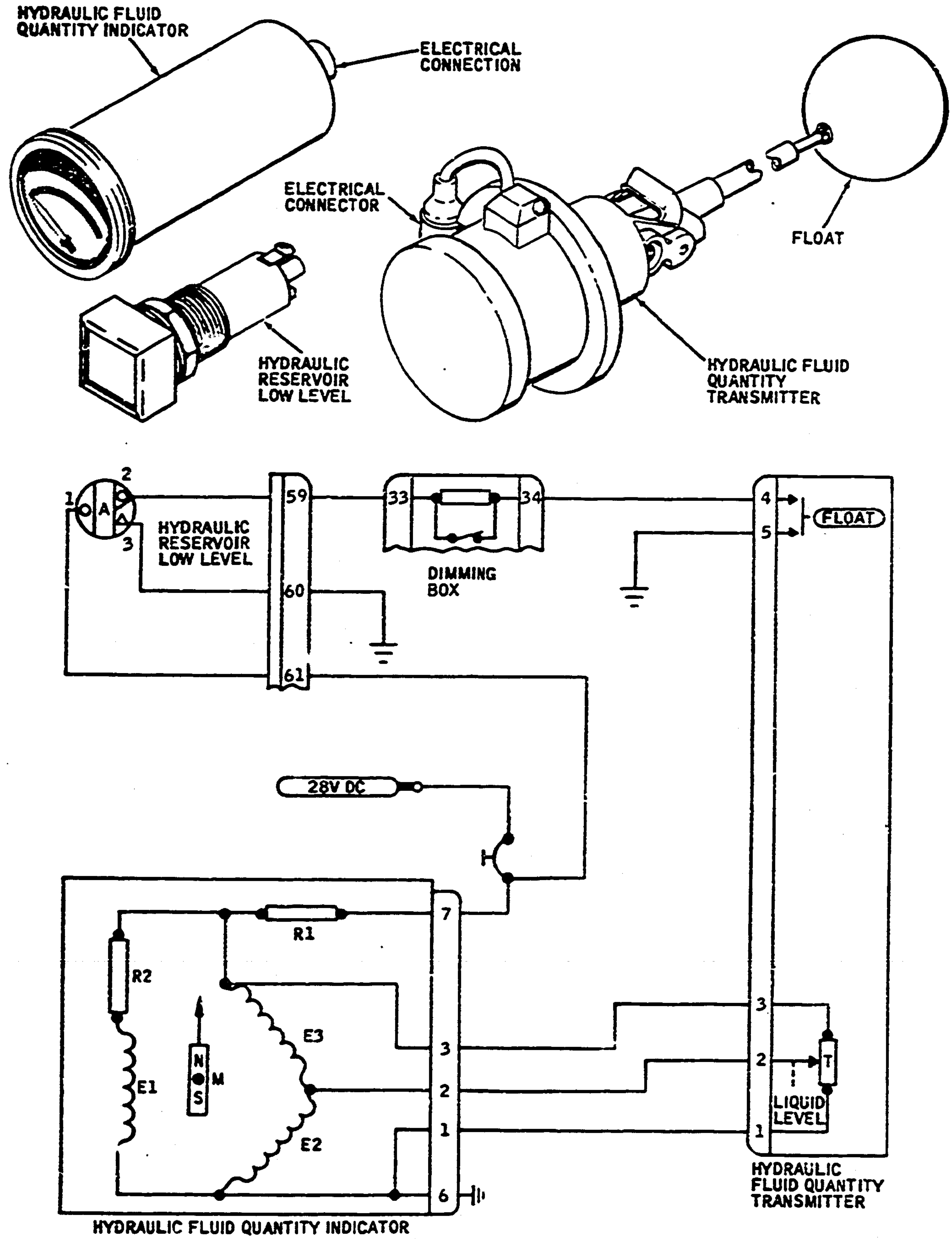
(1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and three (hydraulic reservoir low pressure, hydraulic fluid overtemperature, and emergency reservoir fluid level) are presented by indicating lights.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, a hydraulic reservoir low level indicating light switch, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangement, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the B+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposite effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent magnet (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coils proportionately, therefore



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Hydraulic Fluid Quantity Indicating
System -- Schematic
Figure 1

affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.

3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system is the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb, installed in the reservoir, and an indicator in the flight compartment.

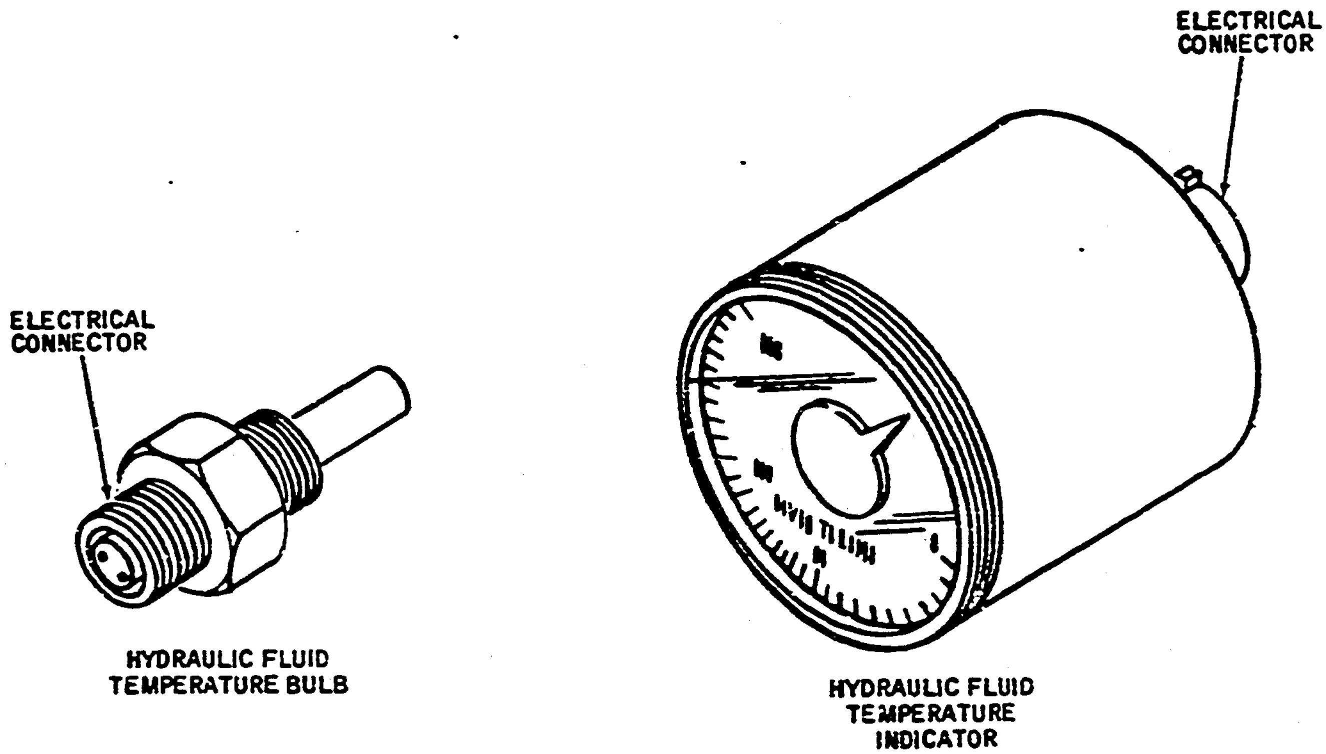
B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanent magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

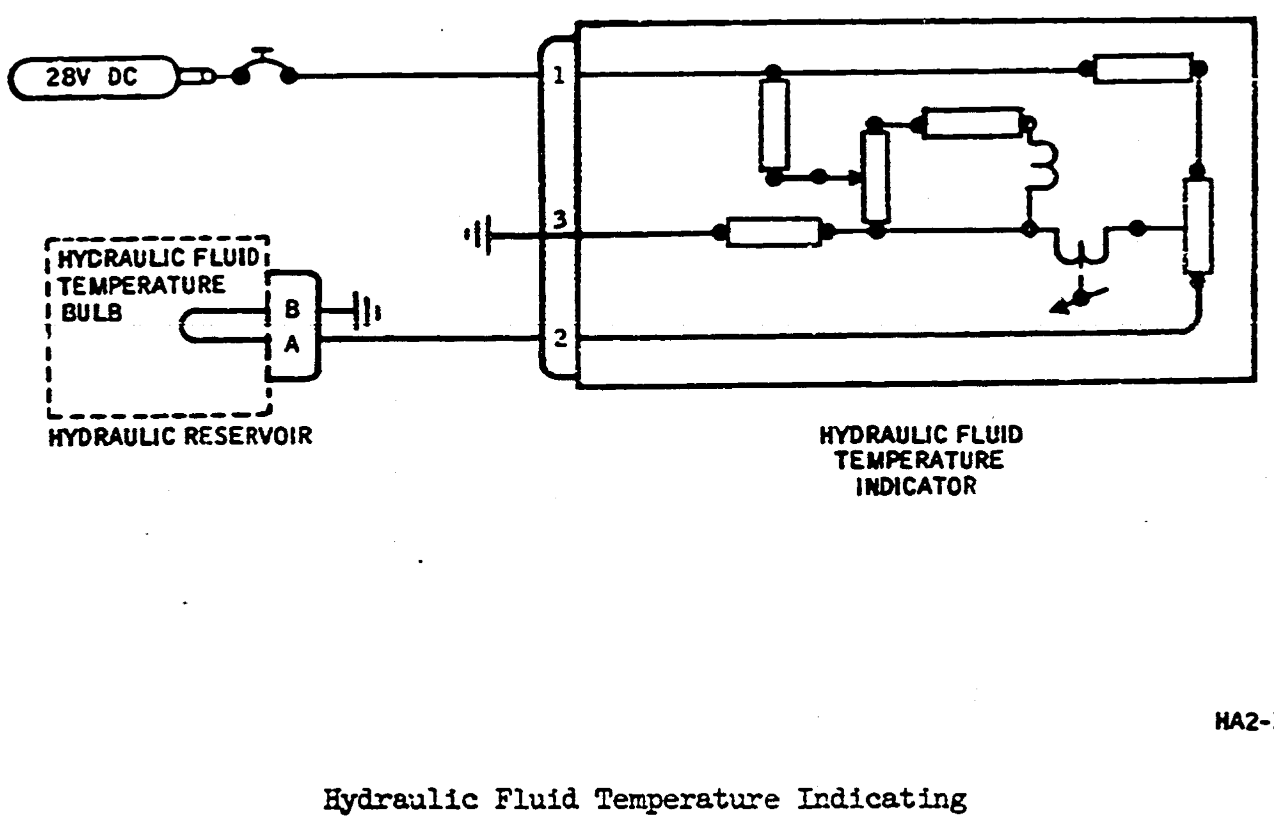
4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter. The transmitter is located in the upper right side of the nosewheel well and is connected by tubing to the hydraulic system pressure lines.

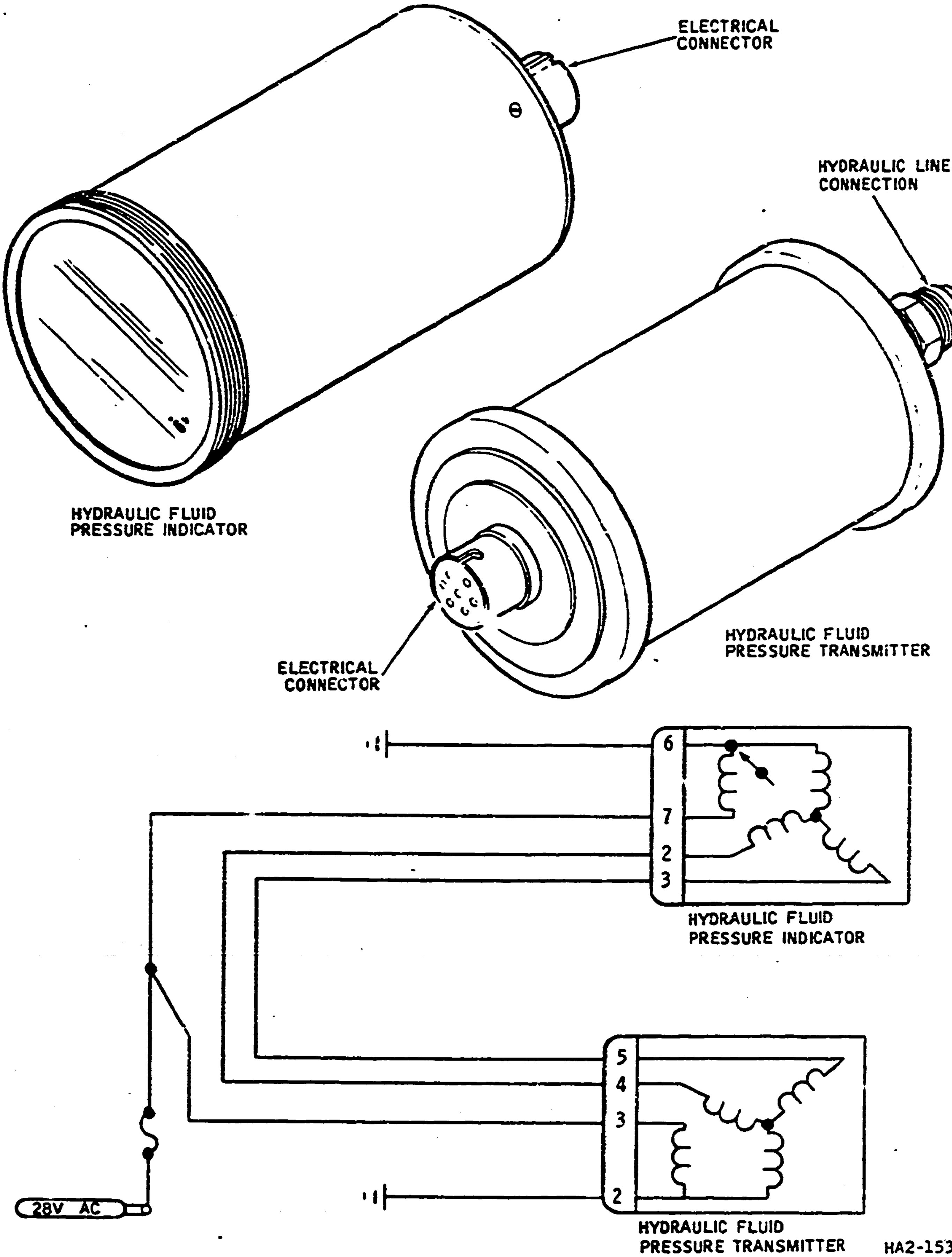
B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 28-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.





Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2



Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3

5. Hydraulic Reservoir Low-Pressure Indicating Light System (See Figure 4.)

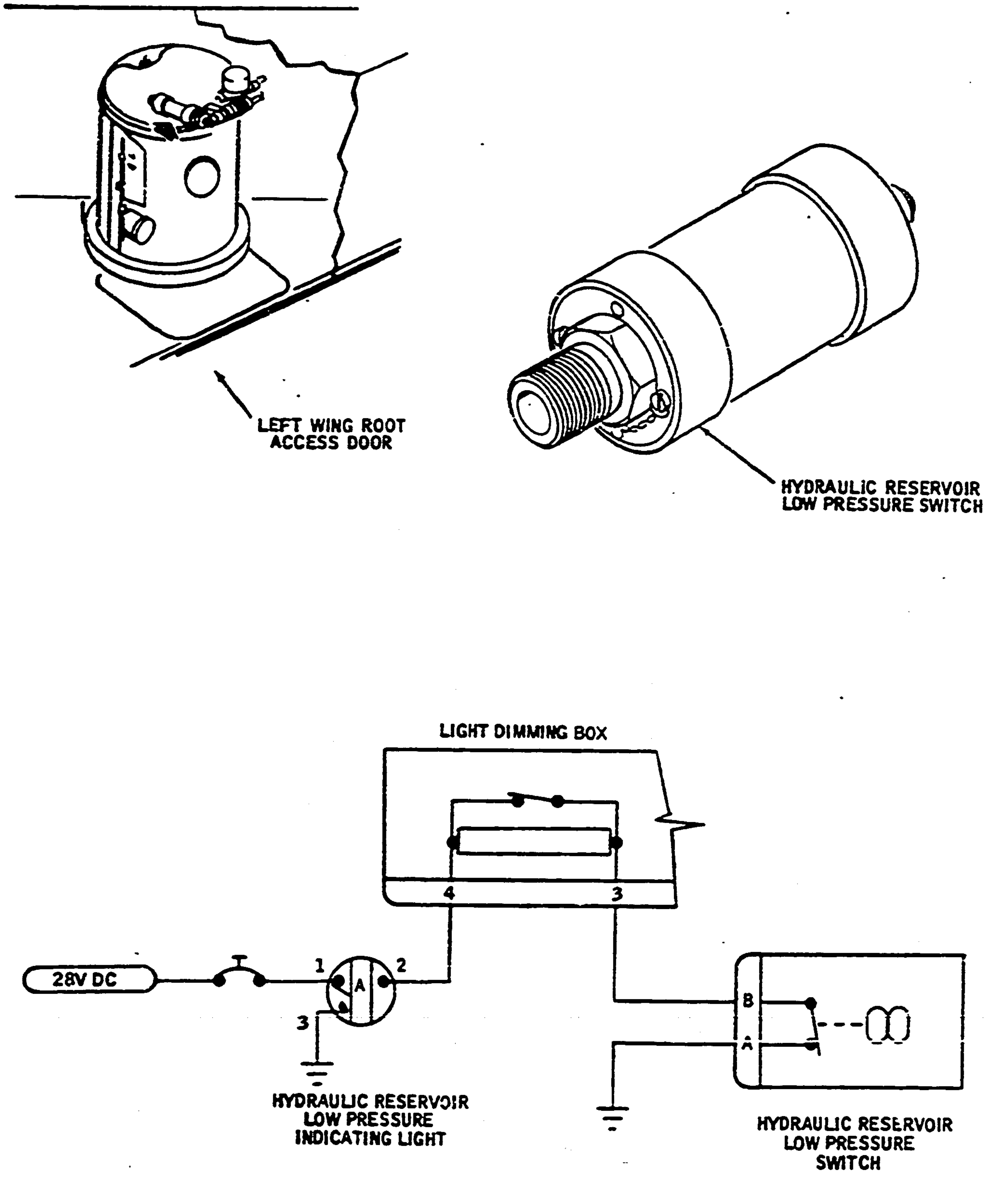
A. The hydraulic reservoir low-pressure indicating light system provides a visual indication of below normal air pressure in the hydraulic reservoir. The system consists of a pressure-actuated switch located on the hydraulic reservoir, a light-dimming switch and resistor, and a press-to-test amber indicator light in the flight compartment. The hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 22 (±2) psi and goes off when pressure reaches 27 (±2) psi.

6. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 5.)

A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an overtemperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°C).

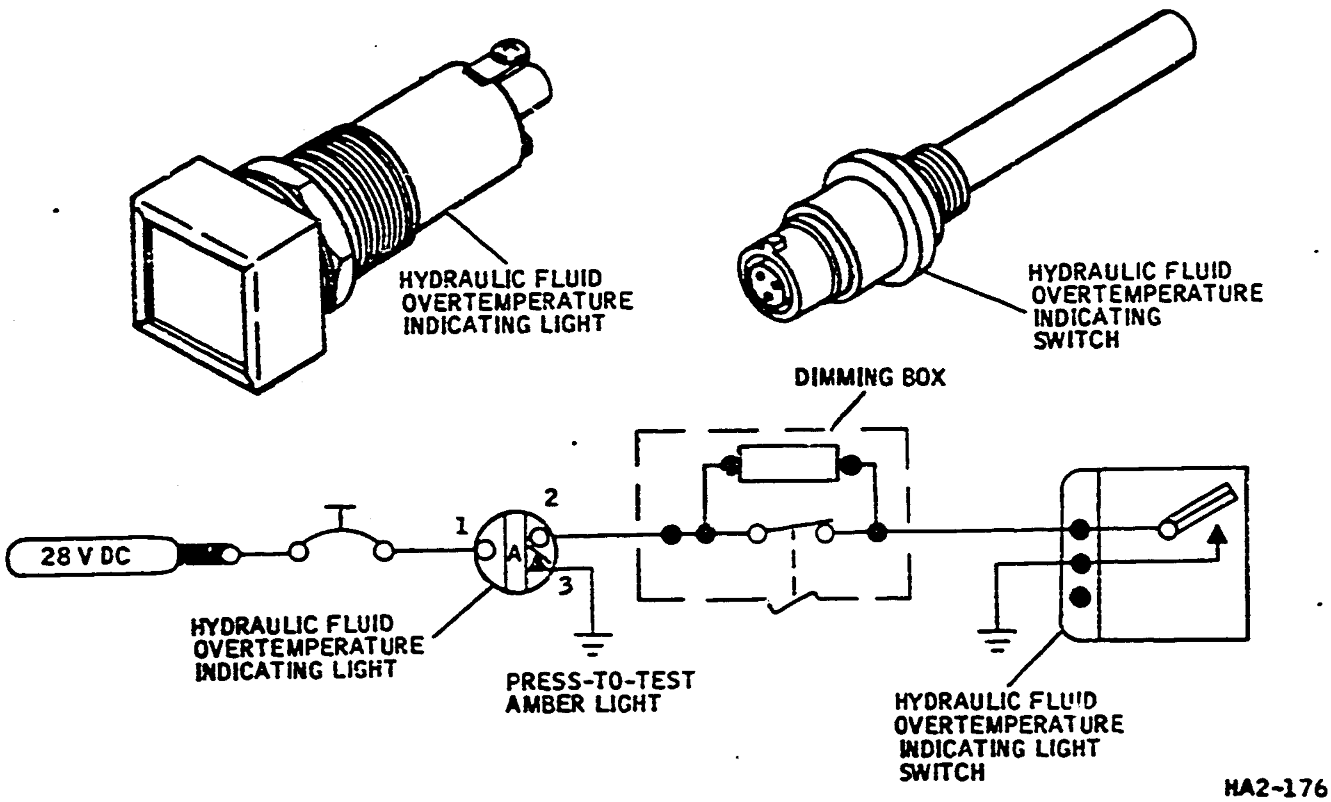
7. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 6.)

A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.

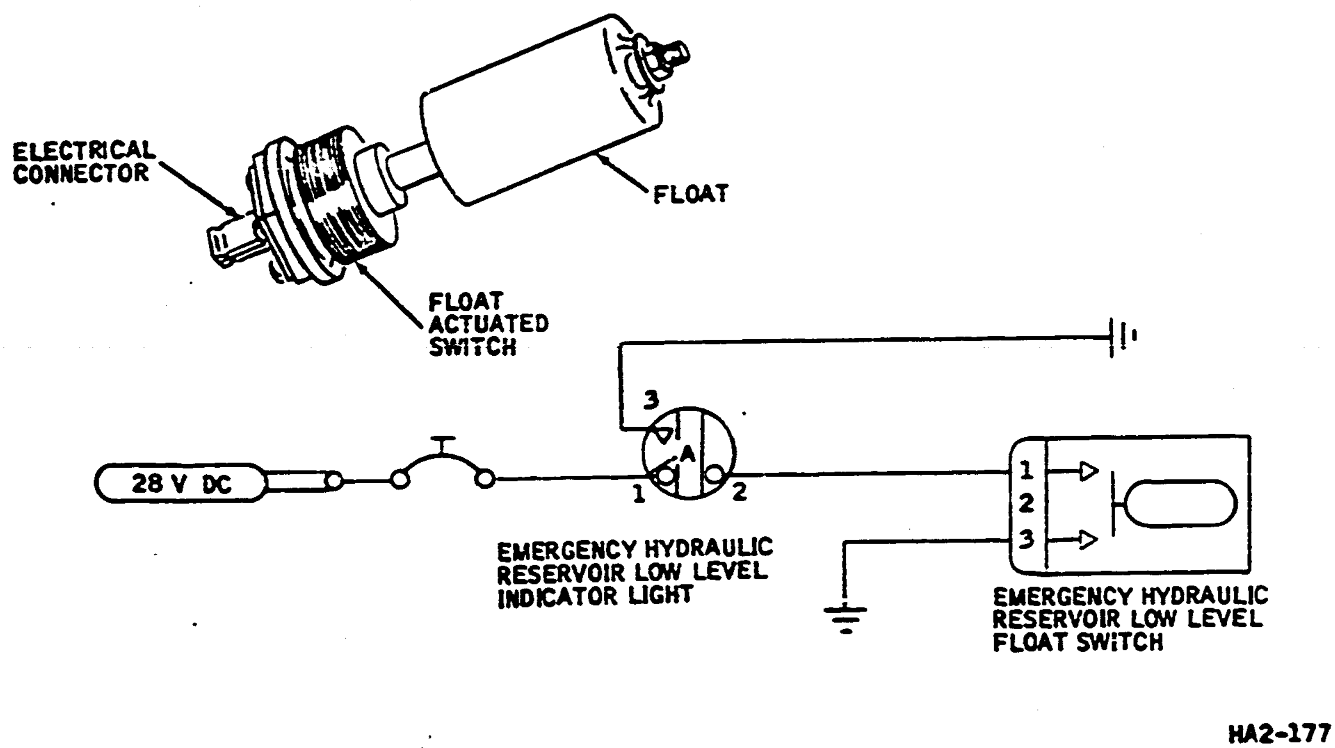


HA2-202

Hydraulic Reservoir Low-Pressure Indicating
Light System -- Schematic
Figure 4



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 5



Emergency Hydraulic Reservoir Low Level
Indicating System -- Schematic
Figure 6

INDICATING - DESCRIPTION AND OPERATION

1. General

A. Description

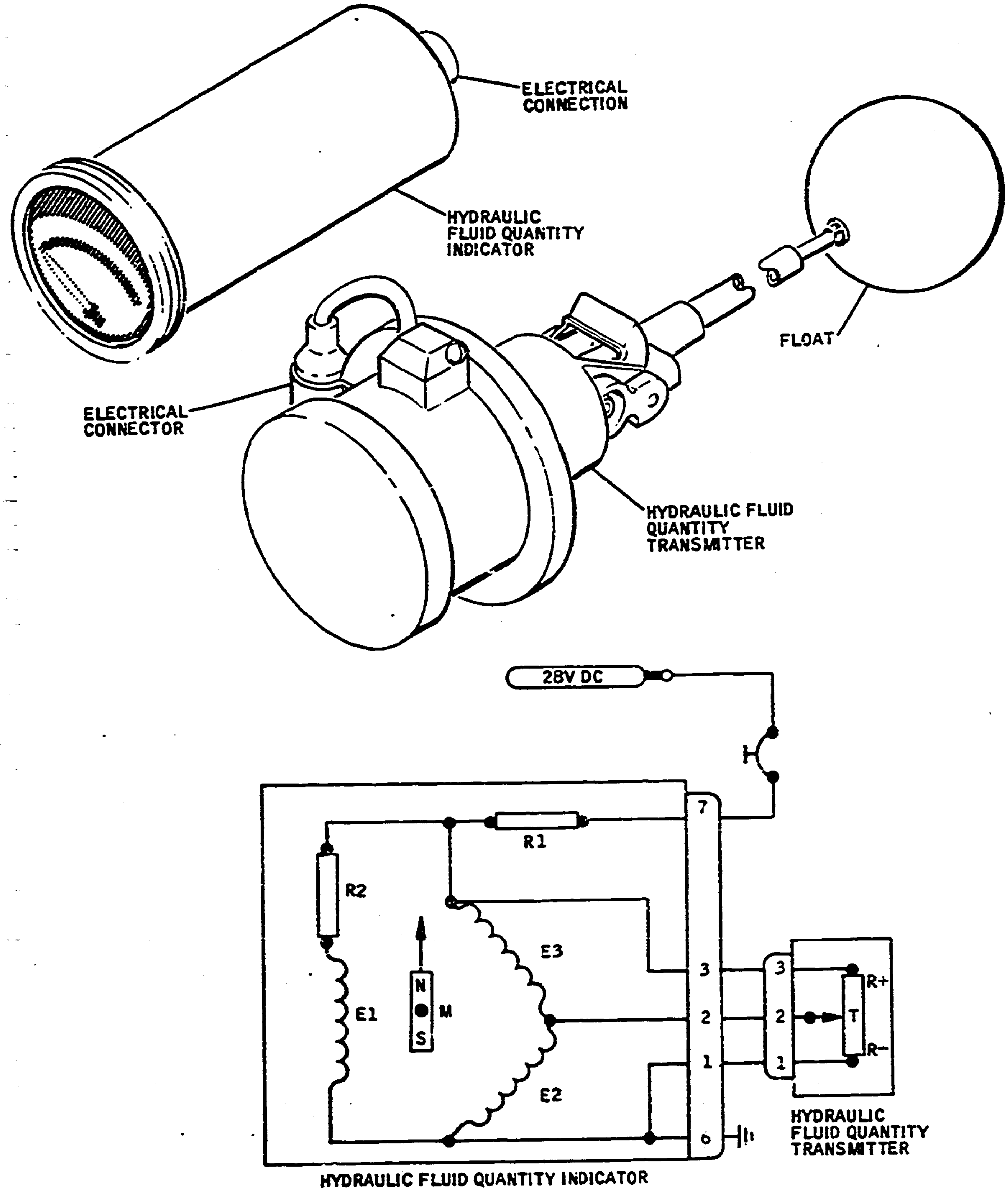
(1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and two (hydraulic fluid overtemperature, and emergency reservoir fluid level) are presented by indicating lights. On airplanes 812-822, 860 and subsequent an additional indication (hydraulic reservoir low pressure) is presented by an indicating light.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangement, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the R+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposite effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent magnet (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coil proportionately,



HA2-151

Hydraulic Fluid Quantity Indicating System -- Schematic
Figure 1

therefore affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.

3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system is the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb, installed in the reservoir, and an indicator in the flight compartment.

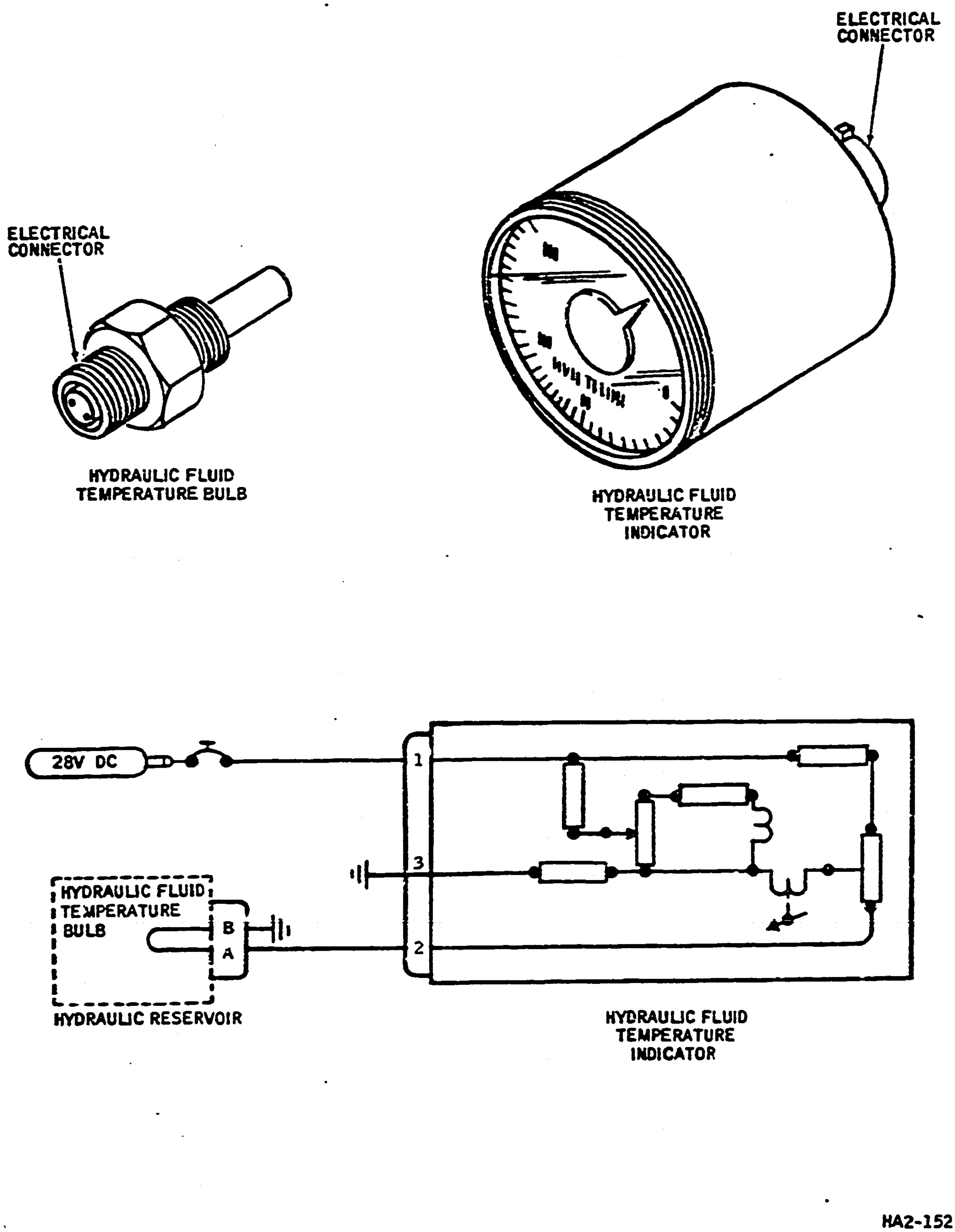
B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanent magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter. The transmitter is located in the upper right side of the nose-wheel well and is connected by tubing to the hydraulic system pressure lines.

B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 28-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.



Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2

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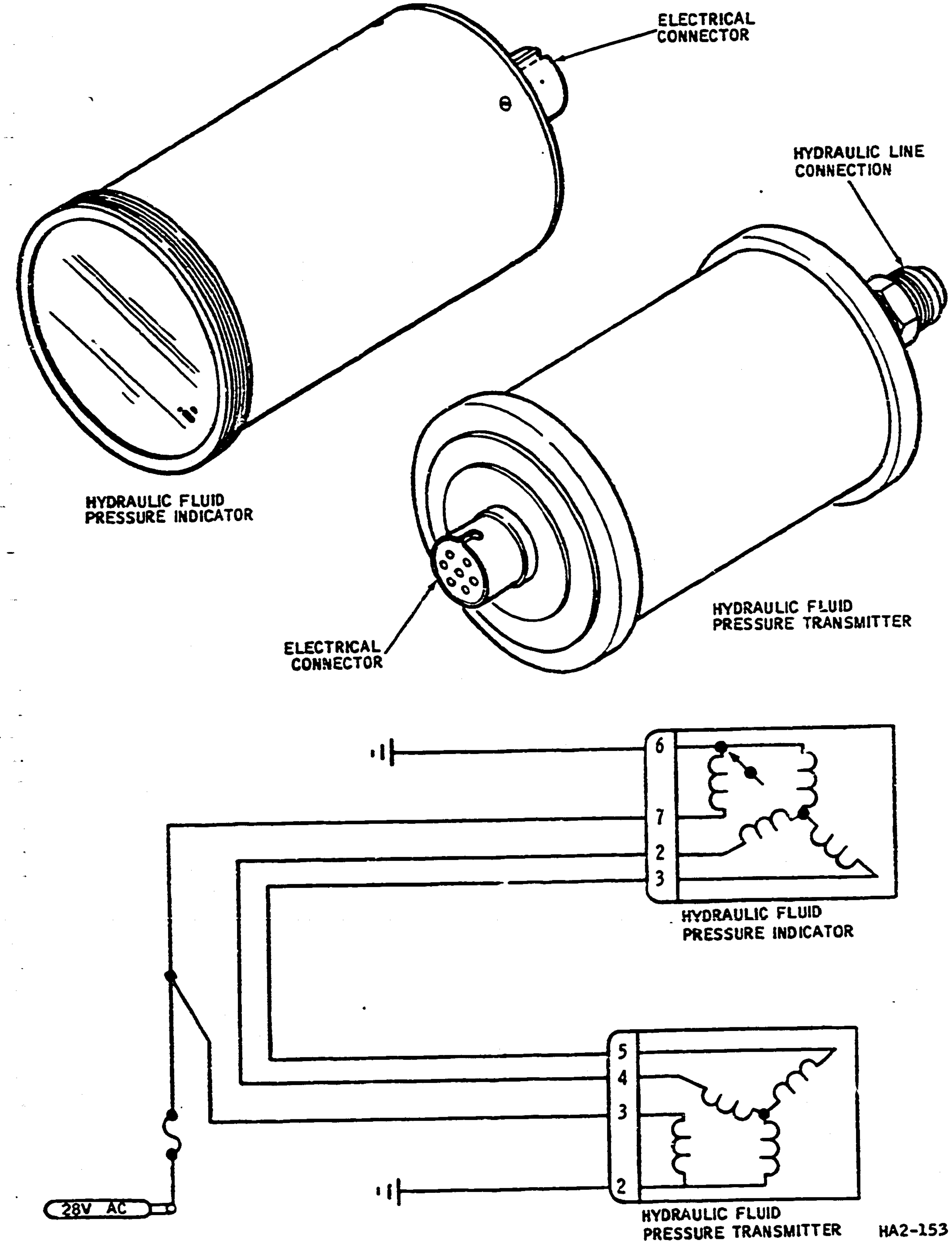


Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3

5. Hydraulic Reservoir Low-Pressure Indicating Light System (Airplanes 812-822, 860 and subsequent) (See Figure 4.)

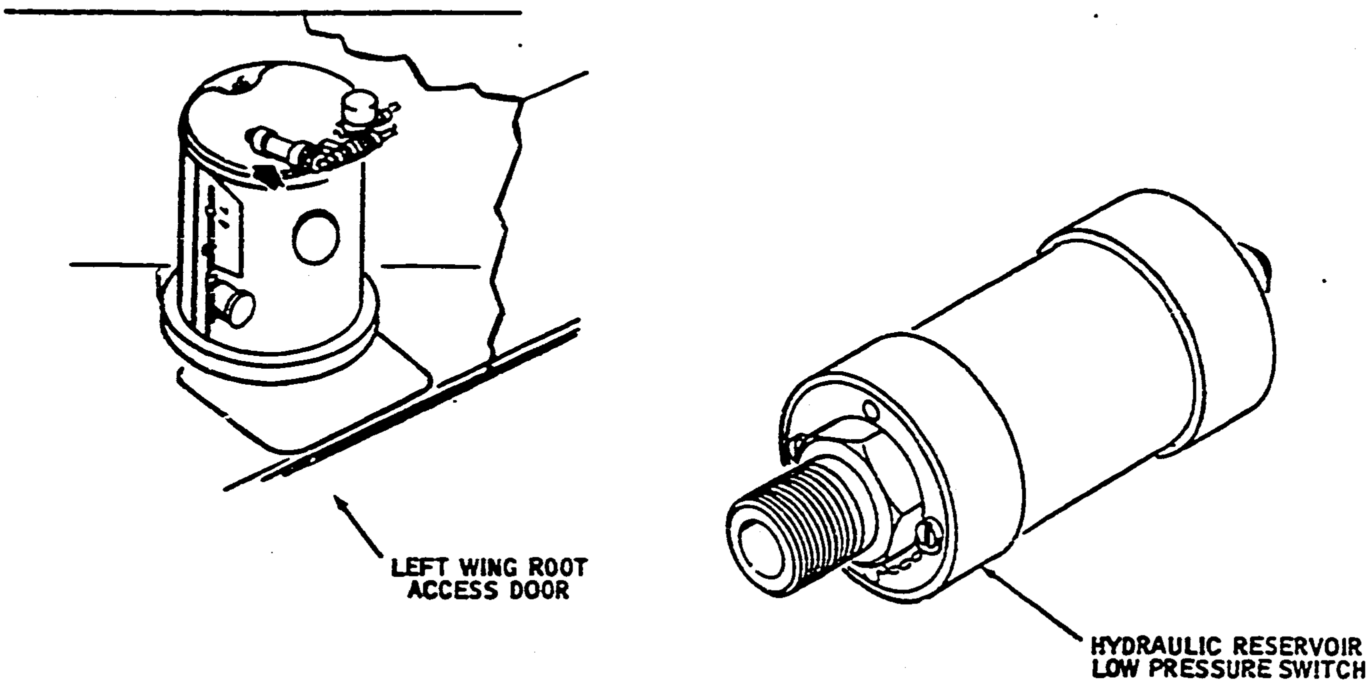
A. The hydraulic reservoir low-pressure indicating light system provides a visual indication of below normal air pressure in the hydraulic reservoir. The system consists of a pressure-actuated switch located on the hydraulic reservoir, a light-dimming switch and resistor, and a press-to-test amber indicator light in the flight compartment. On airplanes 812-822 and 860-876, the hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 25 (±2) psi and goes off when the pressure reaches 30 (±2) psi. On airplanes 877-879, the hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 22 (±2) psi and goes off when pressure reaches 27 (±2) psi.

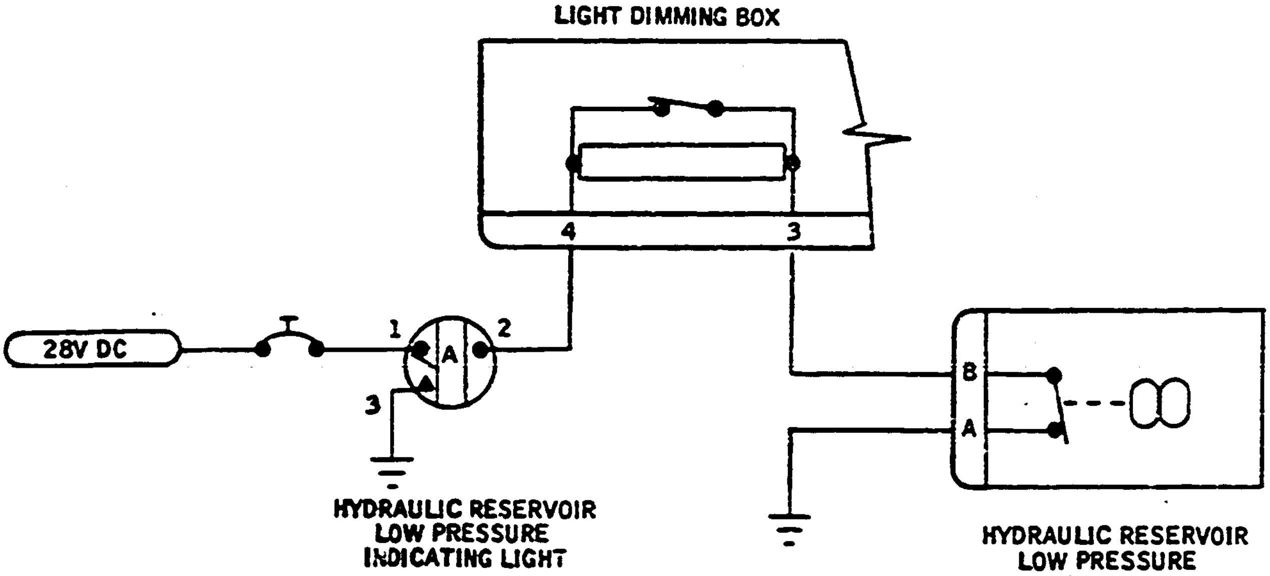
6. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 5.)

A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an overtemperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°F).

7. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 6.)

A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.





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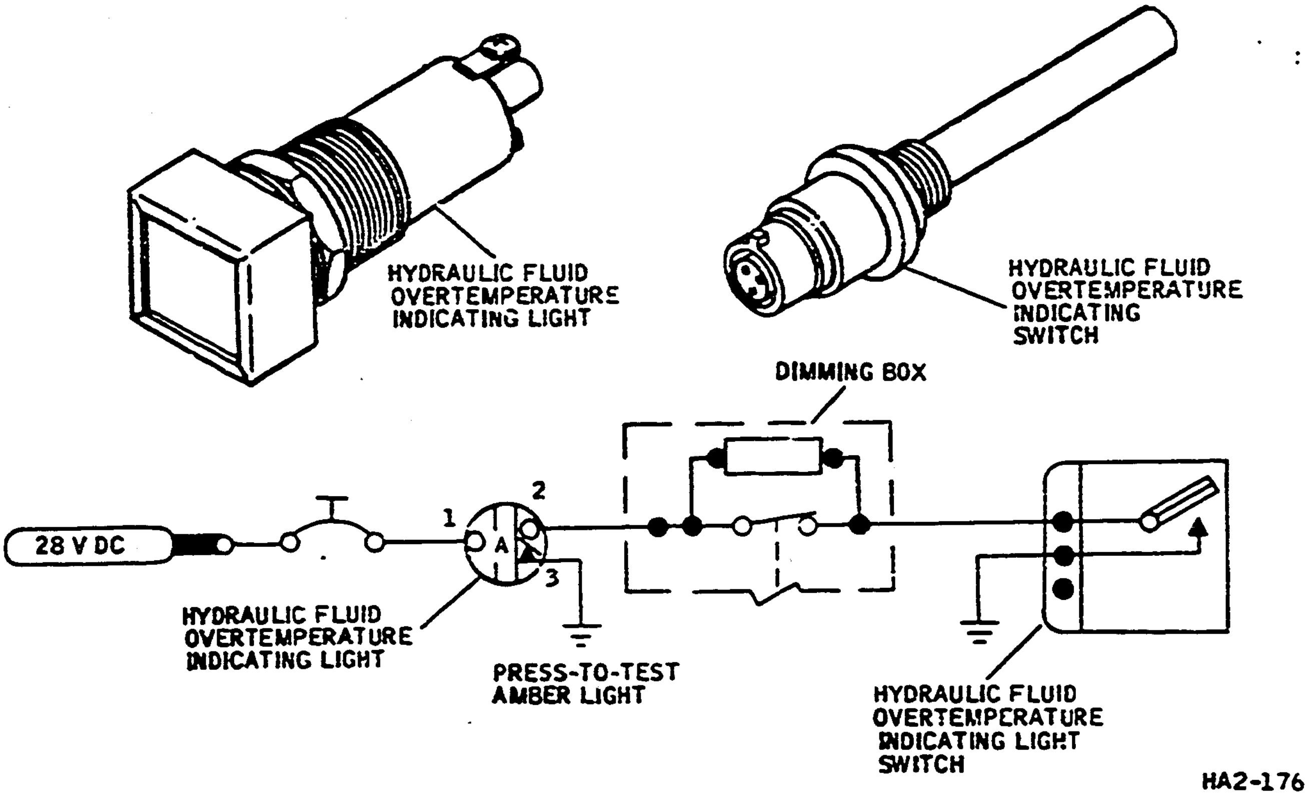
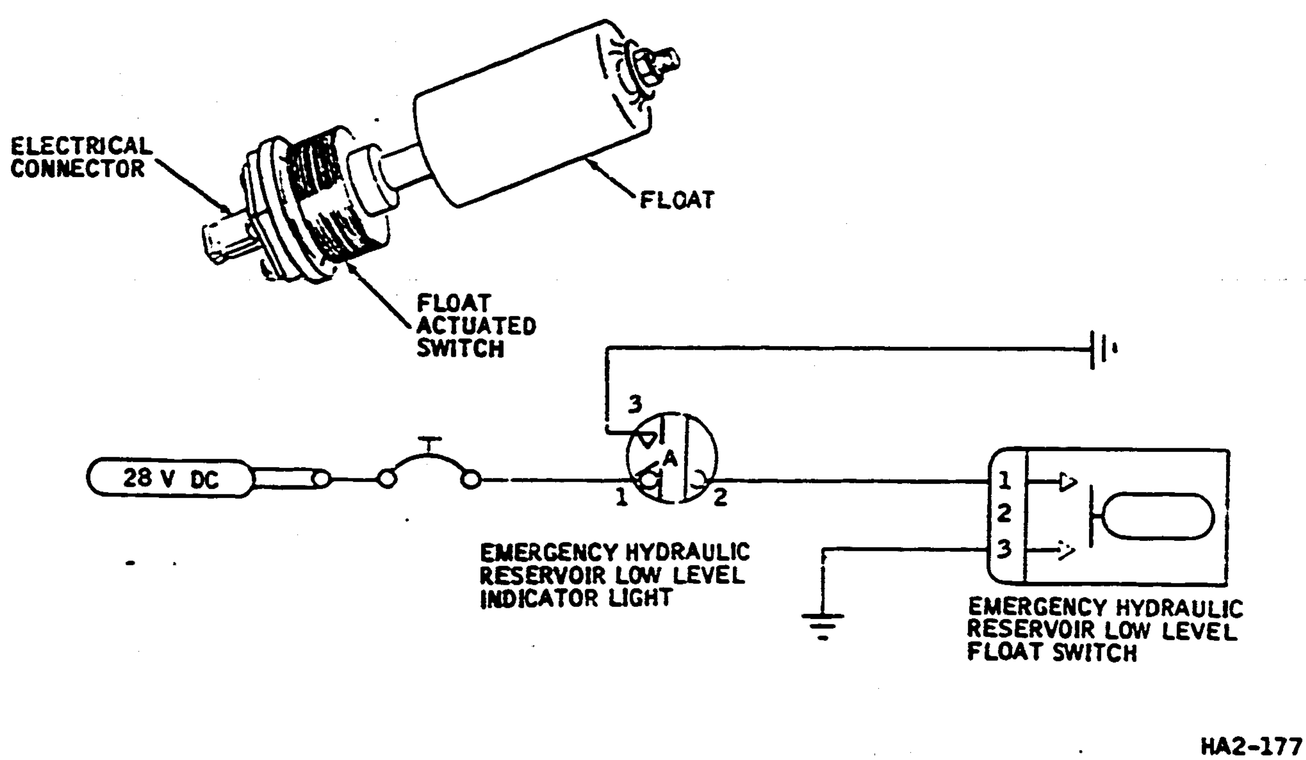
Hydraulic Reservoir Low-Pressure Indicating Light System --
Schematic (Airplanes 812-822, 860 and Subsequent)
Figure 4



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 5



Emergency Hydraulic Reservoir Low Level
Indicating System -- Schematic
Figure 6

INDICATING - DESCRIPTION AND OPERATION

1. General

A. Description

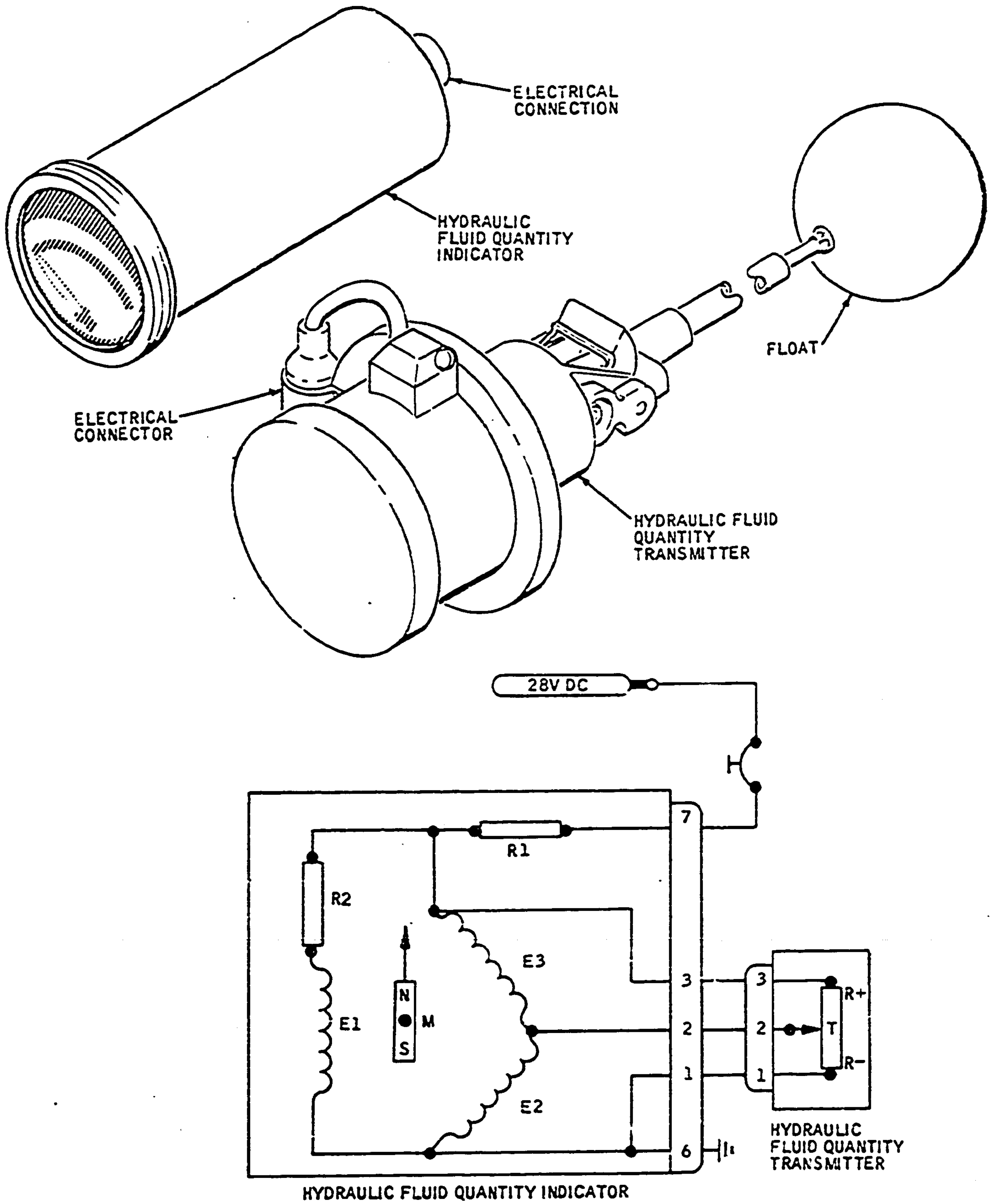
(1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and three (hydraulic reservoir low pressure, hydraulic fluid overtemperature, and emergency reservoir fluid level) are presented by indicating lights.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangements, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the R+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposide effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent manget (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coils proportionately, therefore affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.



Hydraulic Fluid Quantity Indicating System -- Schematic
Figure 1

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3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system in the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb, installed in the reservoir, and an indicator in the flight compartment.

B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanent magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

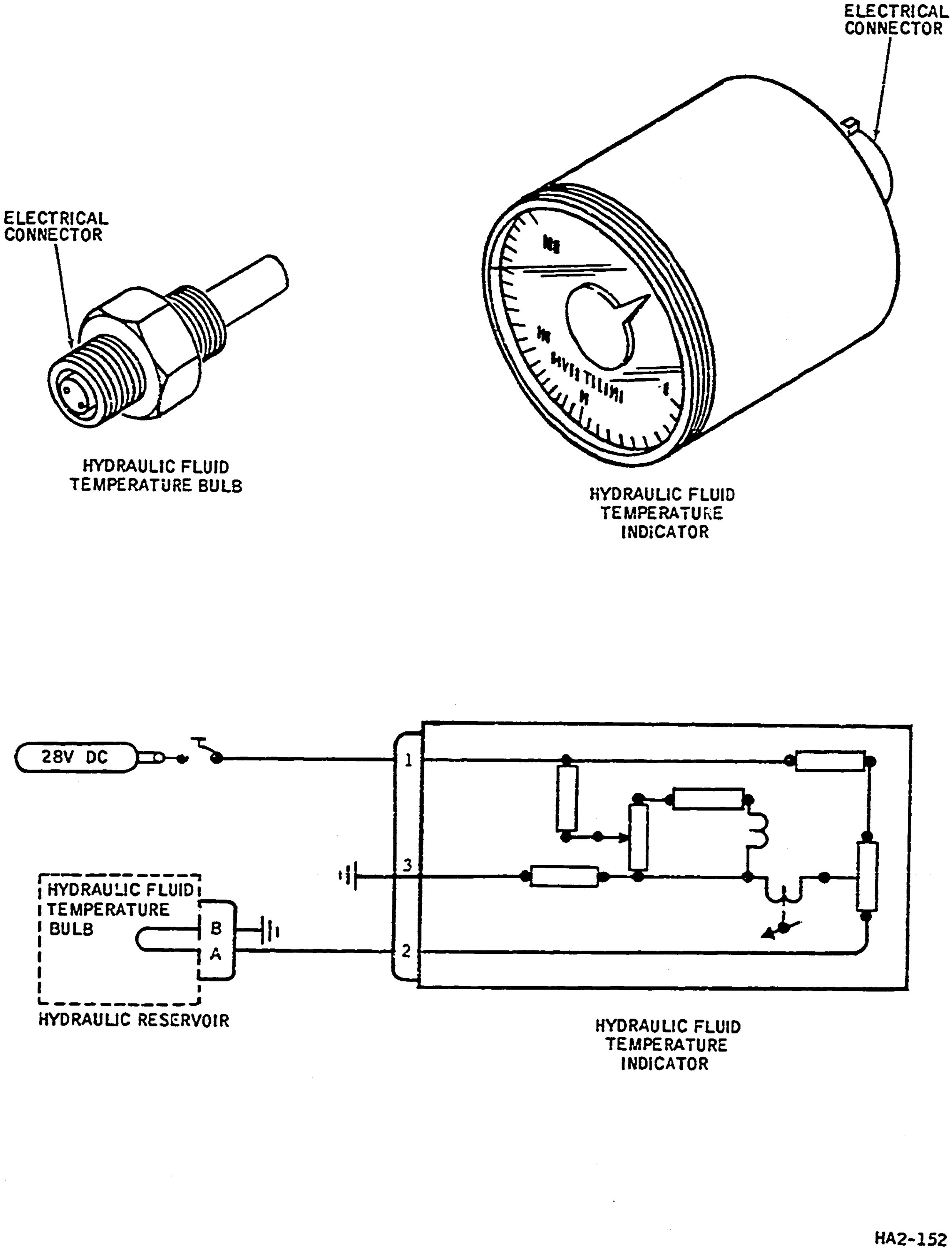
A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter. The transmitter is located in the upper right side of the nosewheel well and is connected by tubing to the hydraulic system pressure lines.

B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 28-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

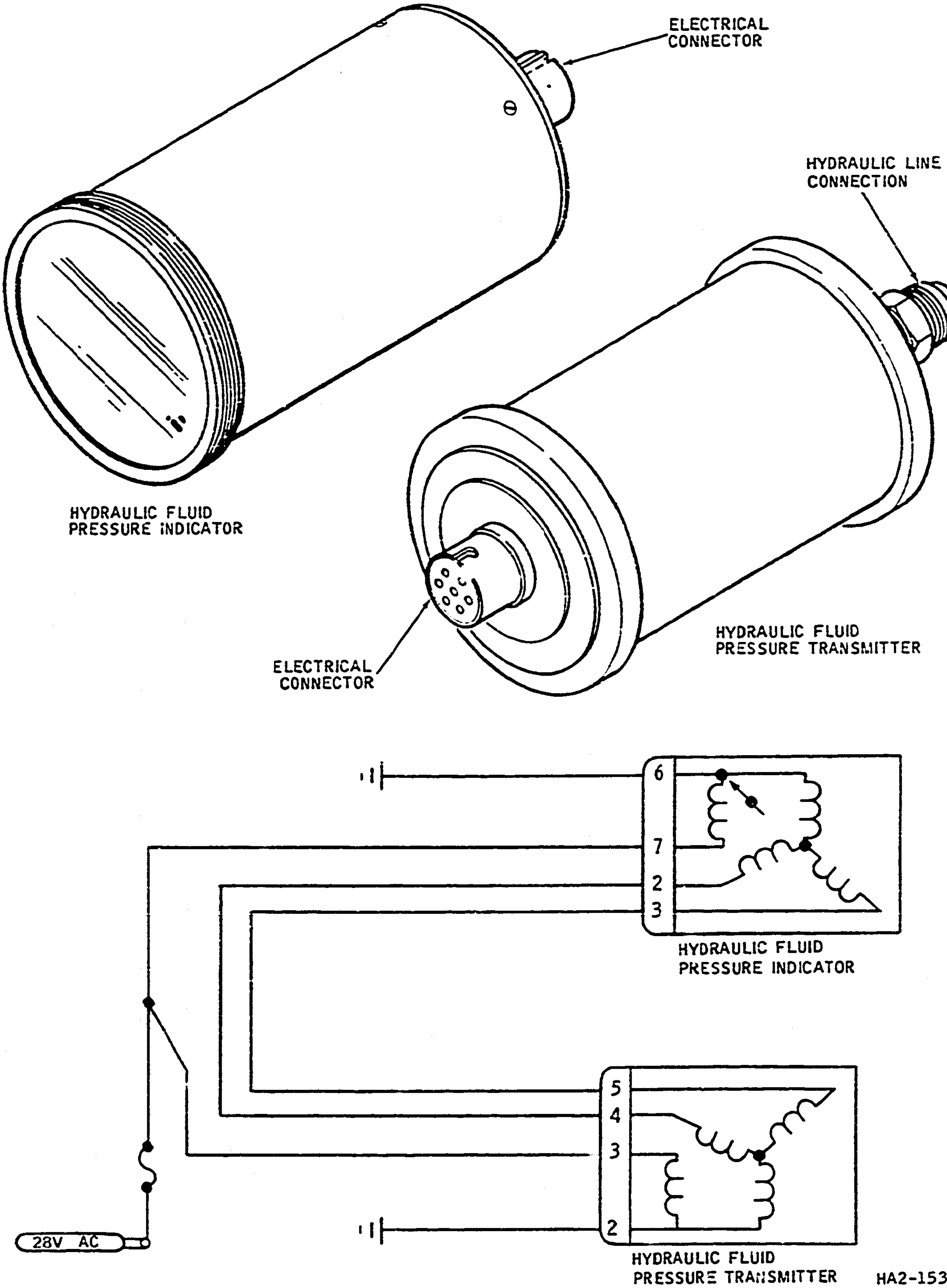
C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.

5. Hydraulic Reservoir Low-Pressure Indicating Light System (See Figure 4.)

A. The hydraulic reservoir low-pressure indicating light system provides a visual indication of below normal air pressure in the hydraulic reservoir.



Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2



Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3

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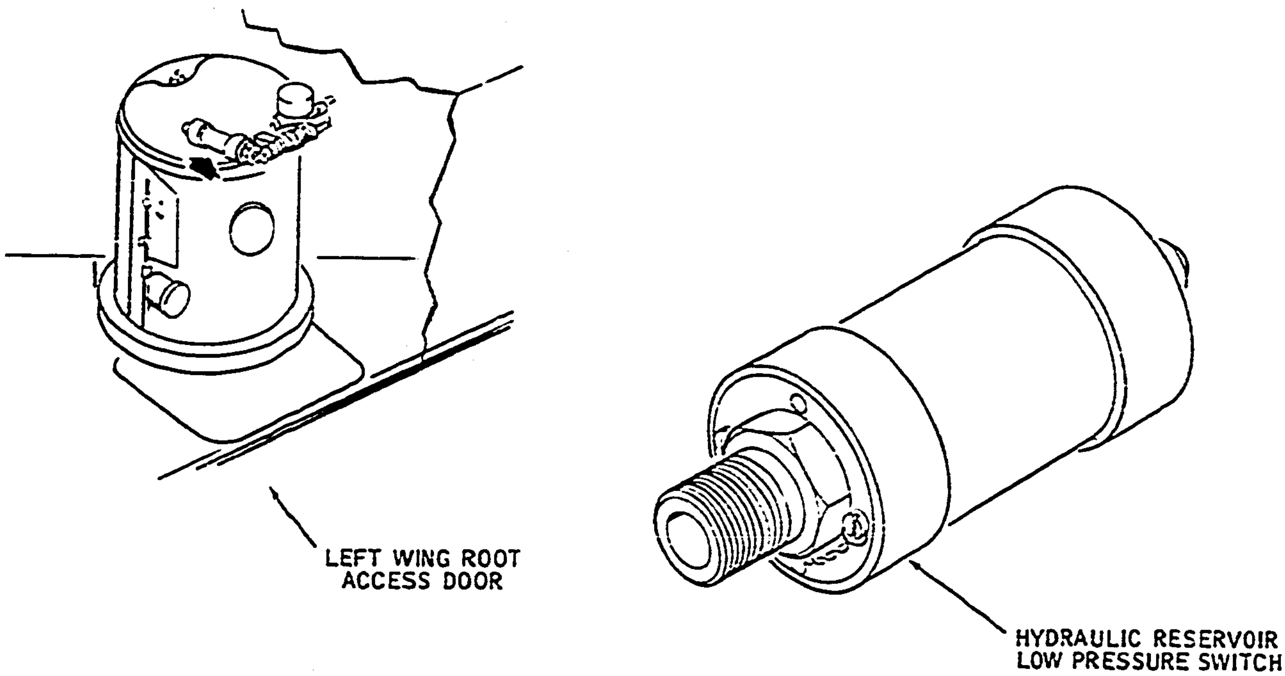
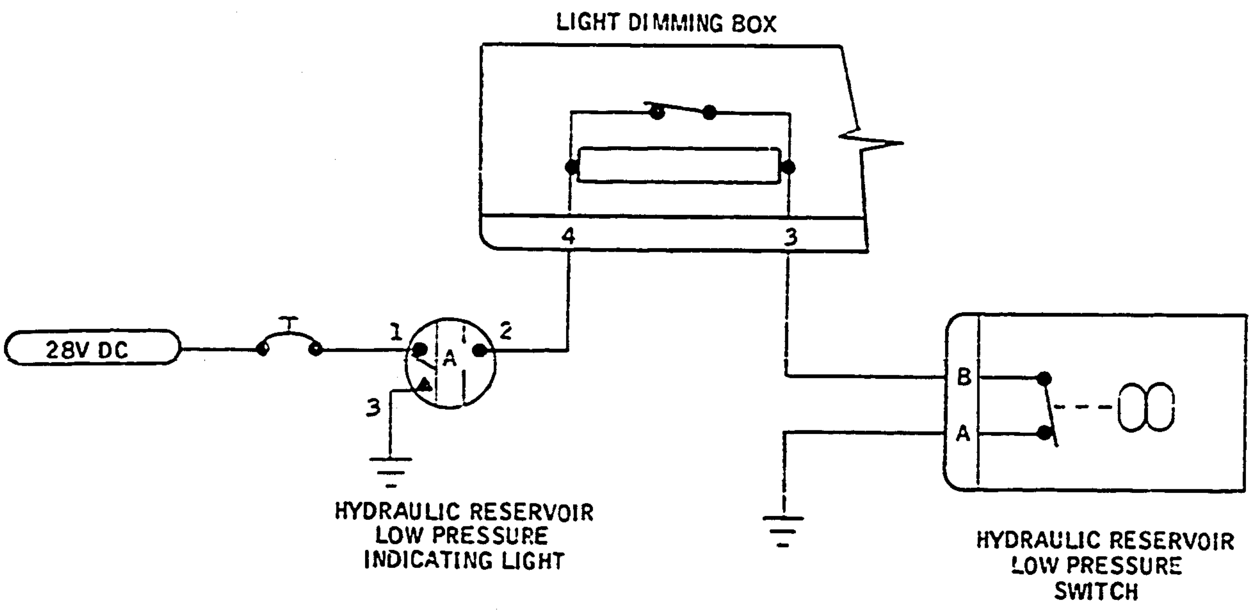




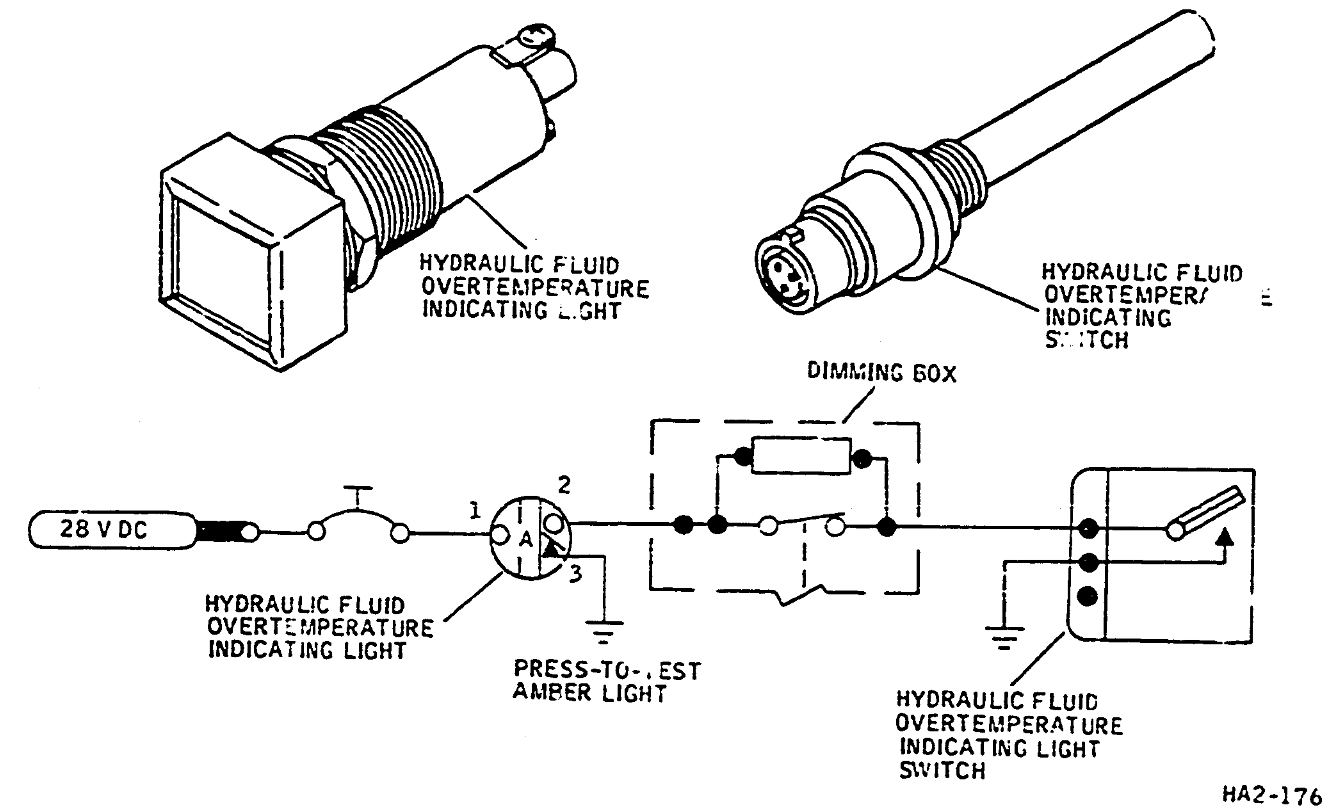
HA2-202

Hydraulic Reservoir Low-Pressure Indicating
Light System -- Schematic
Figure 4

The system consists of a pressure-actuated switch located on the hydraulic reservoir, a light-dimming switch and resistor, and a press-to-test amber indicator light in the flight compartment. The hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 22 (±2) psi and goes off when the pressure reaches 27 (±2) psi.

6. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 5.)

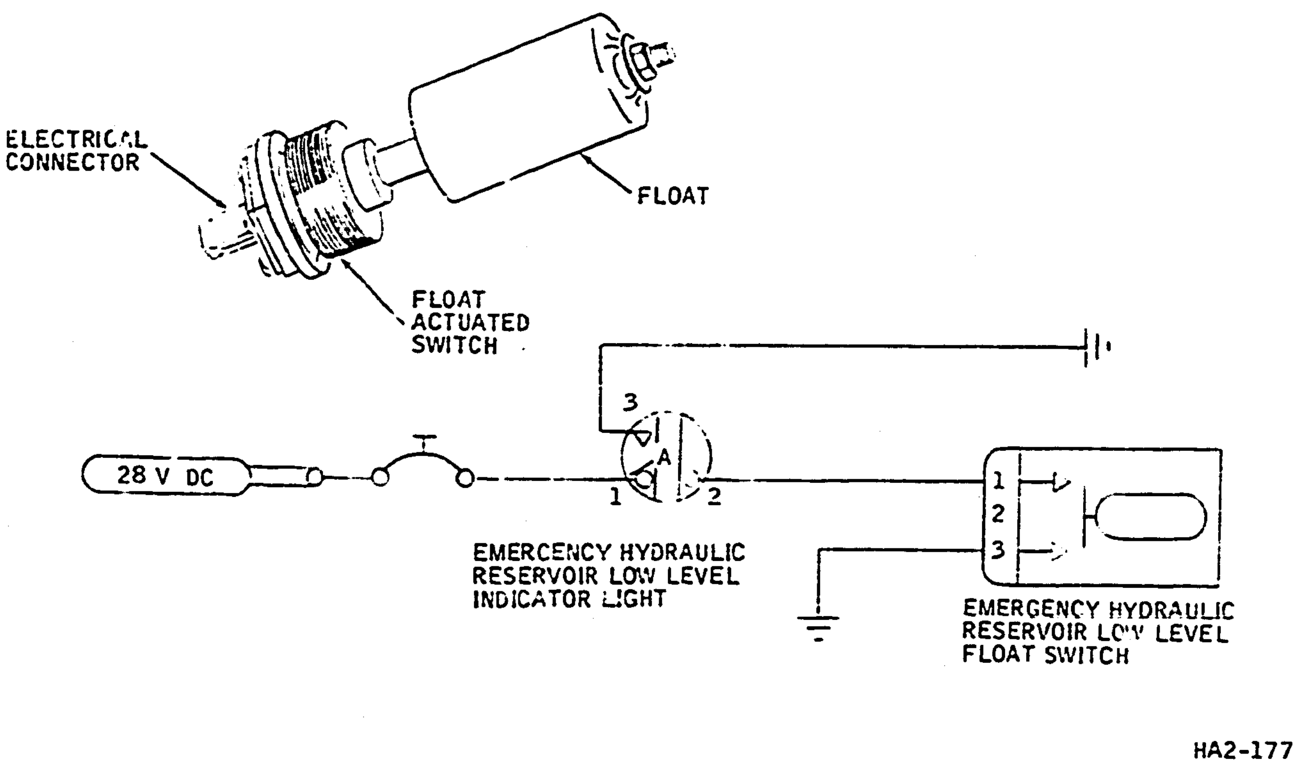
A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an over-temperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°F).



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 5

7. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 6.)

A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.



Emergency Hydraulic Reservoir Low Level
Indicating System -- Schematic
Figure 6

INDICATING - DESCRIPTION AND OPERATION

1. General

A. Description

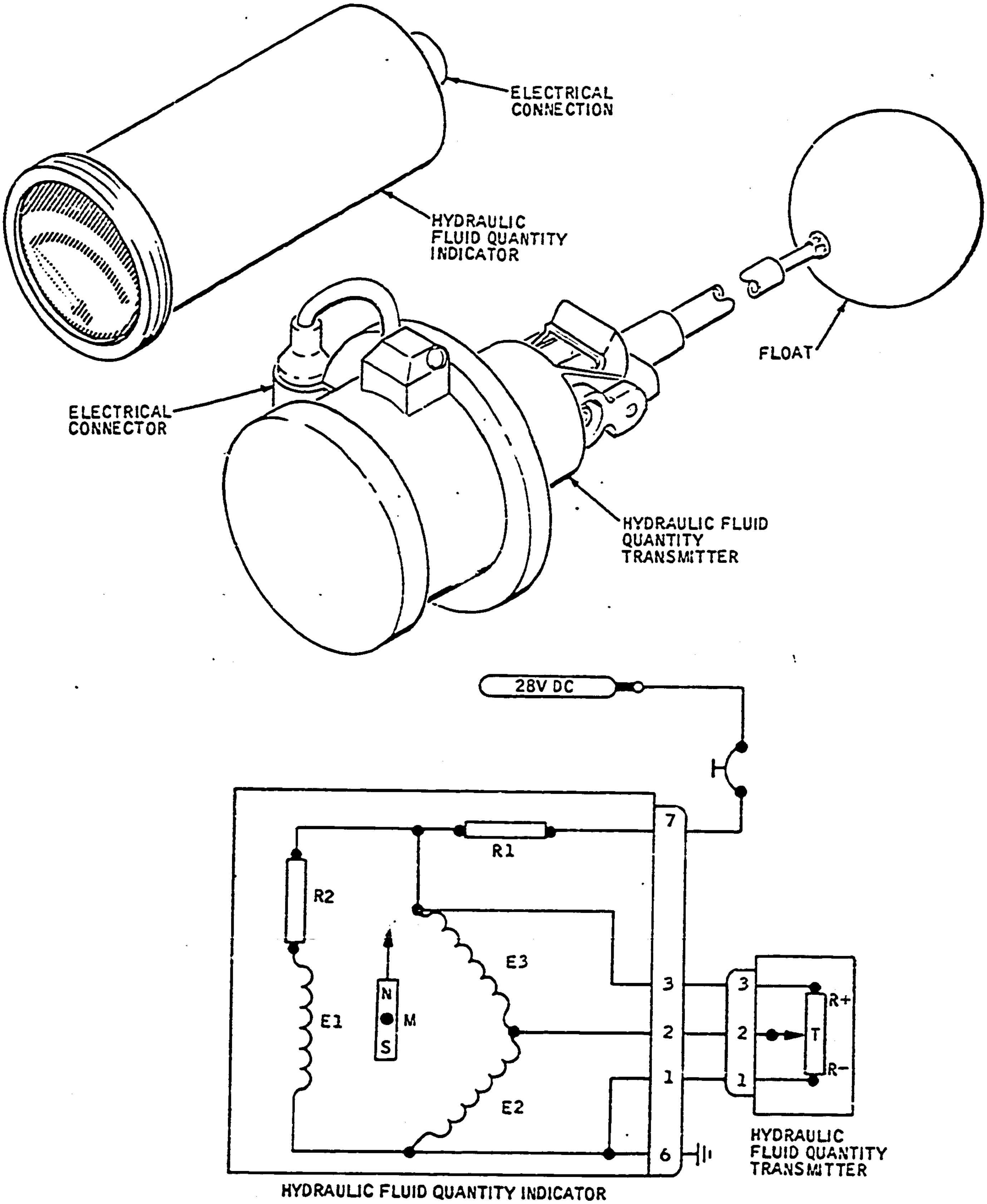
(1) Indicating circuits for the hydraulic power system provide indications in the flight compartment of the status of the hydraulic power system during operation. Five separate indications are provided; three (hydraulic fluid quantity, temperature, and pressure) are presented on indicating gages and four (hydraulic reservoir low pressure, hydraulic fluid overtemperature, emergency reservoir fluid level, and hydraulic pump low pressure) are presented by indicating lights.

2. Hydraulic Fluid Quantity Indicating System (See Figure 1.)

A. The hydraulic fluid quantity indicating system consists of a ratiometer-type indicator, a tank unit (transmitter) bolted to an external flanged adapter on the reservoir, and interconnecting wiring. Changes in the fluid level in the hydraulic system reservoir are followed by a float. The motion of the float is transmitted by means of a linkage arrangement, to the contact arm (wiper arm) of a potentiometer inside of the head of the transmitter. The potentiometer is wired to the indicator. The indicator consists of a rotor surrounded by three electromagnets. As the potentiometer contact arm moves, the indicator rotor is positioned accordingly. The indicator pointer is attached directly to the rotor and thus shows liquid quantity. The indicator is marked hydraulic oil quantity.

B. When the hydraulic reservoir is full, the fluid quantity indicator in the flight compartment pegs at a point equivalent to 11.5 US gallons (9.56 Imperial gallons, 43.52 liters). There are 1.4 US gallons (1.16 Imperial gallons, 5.29 liters) in the reservoir not recorded; as a result, the indicator does not move until this amount of fluid is depleted.

C. In operation, the voltage across E1 is constant. The position of the contact arm (wiper arm) in the transmitter determines the voltage across E2 and E3. When the contact arm in the transmitter is moved in the R+ direction, the voltage across coil E2 is increased while the voltage across E3 is decreased. When the contact arm is moved in the R- direction, the opposite effect takes place. From these voltages, magnetic flux is produced in each coil proportional to the voltage drop across the coil. The electrical circuit causes the resultant of the three coil fluxes to rotate in a clockwise direction, as the contact arm is moved toward the R- position. The permanent magnet (M) reacts with the resultant flux, producing a torque which causes the magnet to rotate and become magnetically aligned with the resultant coil flux. Moderate supply voltage variation does not affect the positioning of the pointer on the indicator scale. A voltage variation affects each of the coils proportionately, therefore affecting only the magnitude of the resultant flux, but not the direction. When the system power is off, a magnet in the indicator pulls the pointer off the scale.



HA2-151

Hydraulic Fluid Quantity Indicating
System -- Schematic
Figure 1

3. Hydraulic Fluid Temperature Indicating System (See Figure 2.)

A. The hydraulic fluid temperature indicating system is the ratiometer-type which provides an indication of hydraulic fluid temperature in the reservoir. The system consists of a temperature bulb installed in the reservoir, and an indicator in the flight compartment.

B. The hydraulic fluid temperature indicator operates on the electrical bridge principle, with the temperature bulb forming one leg of the bridge circuit. The indicator armature has two coils turning in the air gap of permanent magnets. A large deflecting coil functions much the same as a galvanometer. A small restoring coil is connected in series with one leg of the bridge and opposes the motion of the deflecting coil. Three hairsprings connect the coils to the circuit; one is common to both coils. Two slide-wire potentiometers are provided; one adjusts calibration at center scale and the other expands or contracts the scale ends. When deenergized, a spring-operated device returns the pointer to a position below the scale arc. The indicator is calibrated from -50°C to +150°C (-58°F to 302°F). The temperature bulb has a range of -70°C to +300°C (-94°F to 572°F).

4. Hydraulic Fluid Pressure Indicating System (See Figure 3.)

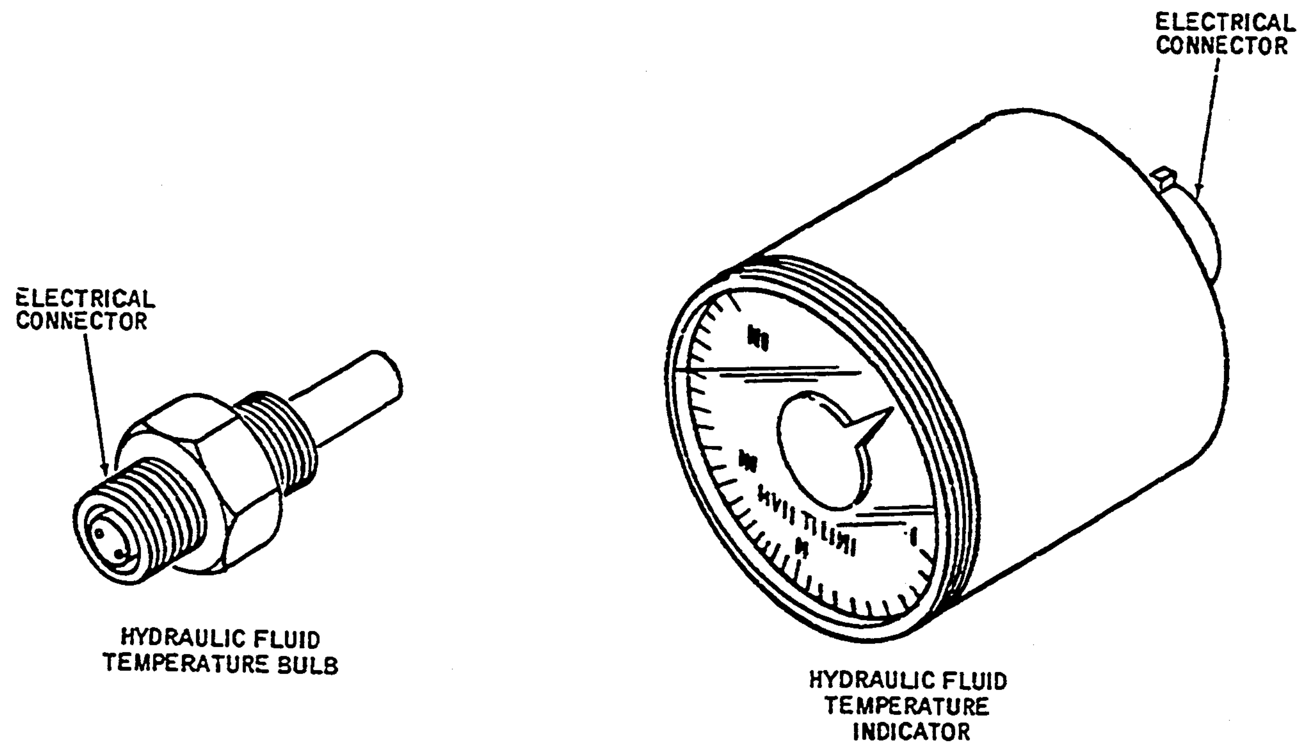
A. The hydraulic fluid pressure indicating system is the synchro-type and indicates the fluid pressure in the hydraulic power system. The system consists of an indicator, located in the flight compartment, and a transmitter. The transmitter is located in the upper right side of the nosewheel well and is connected by tubing to the hydraulic system pressure lines.

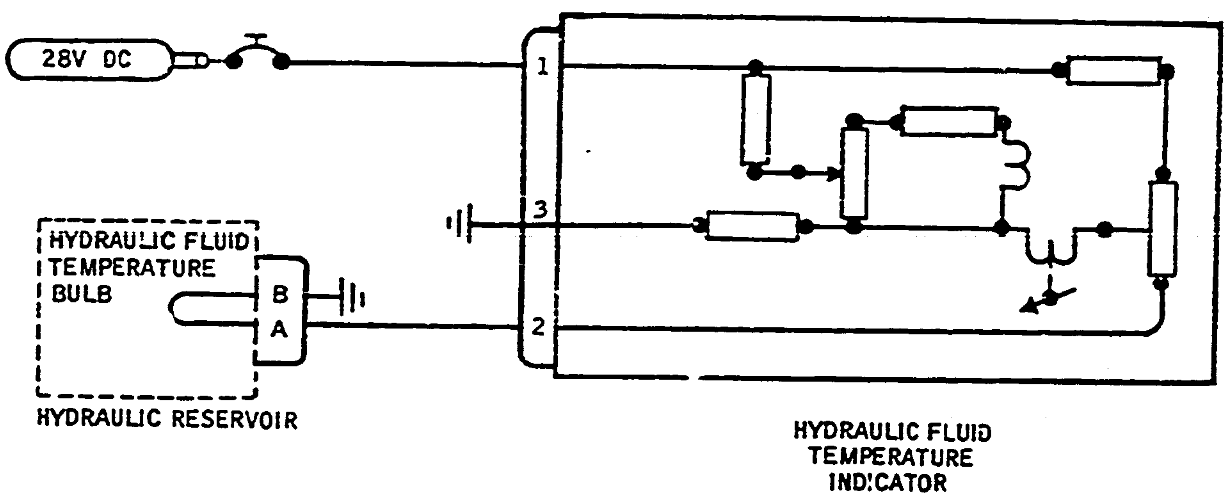
B. The hydraulic fluid pressure indicator consists of a pointer mounted on the shaft of a synchro repeater and is contained within a nonhermetically sealed aluminum case. The indicator is electrically connected to a 28-vac, 400-cycle power source and to a remote, synchro-type pressure transmitter. The indicator is internally lighted by a 5.4-volt lamp bulb.

C. The stator and rotor of the synchro repeater are electrically connected in parallel to the stator and rotor of the remote pressure transmitter. When both units are energized from the same source, the repeater rotor assumes an identical position to that of the transmitter rotor, which is positioned by action of hydraulic pressure. Thus the indicator indicates the pressure on the dial which is calibrated in psig from 0 to 4 times 1000. If the system electrical power fails, the pointer tends to remain at the last indicated position. A direct-reading gage, located on the hydraulic system accumulator in the left main gear wheel well, also indicates the hydraulic system pressure.

5. Hydraulic Reservoir Low-Pressure Indicating Light System (See Figure 4.)

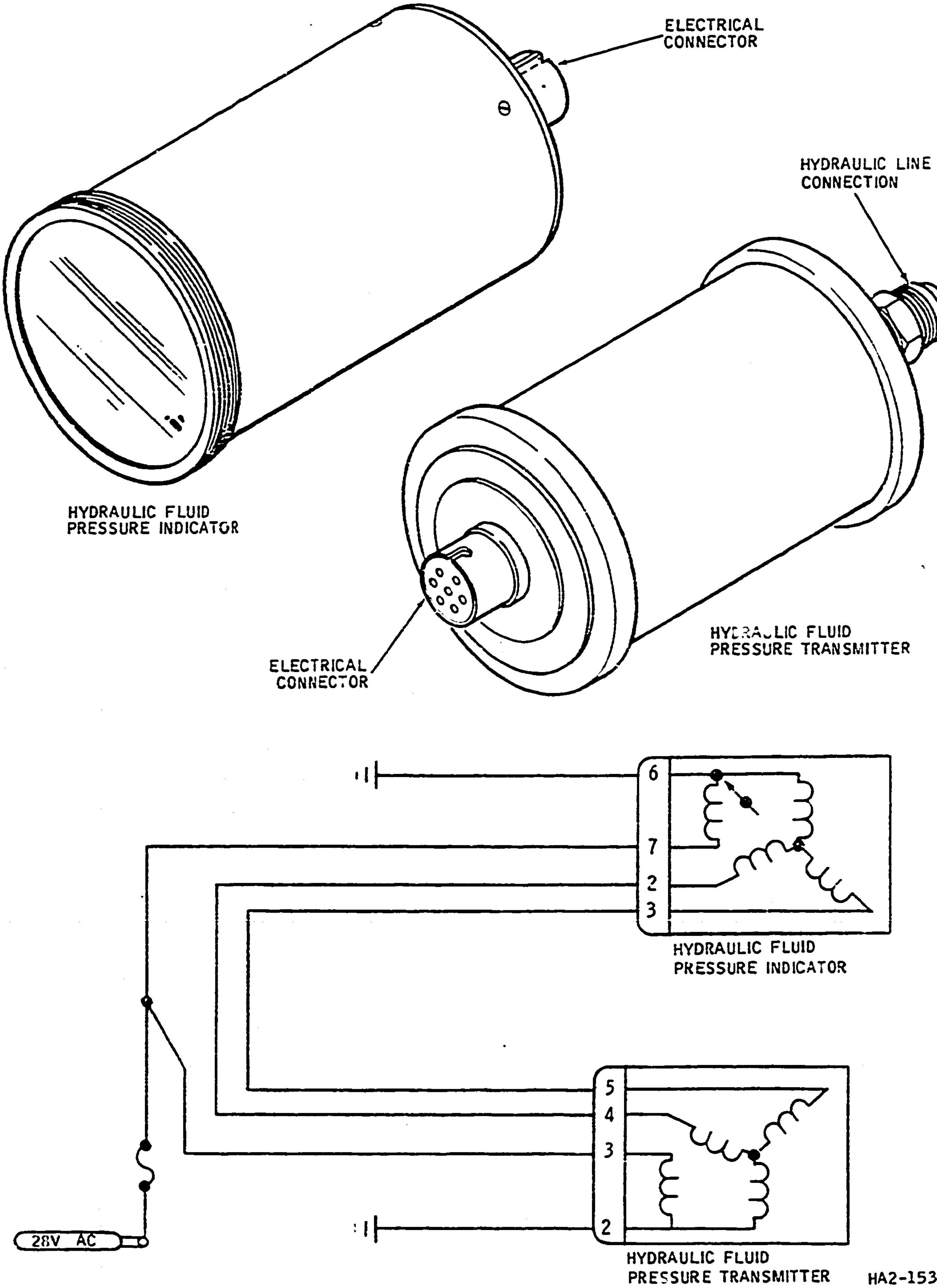
A. The hydraulic reservoir low-pressure indicating light system provides a visual indication of below normal air pressure in the hydraulic reservoir. The system consists of a pressure-actuated switch located on the hydraulic



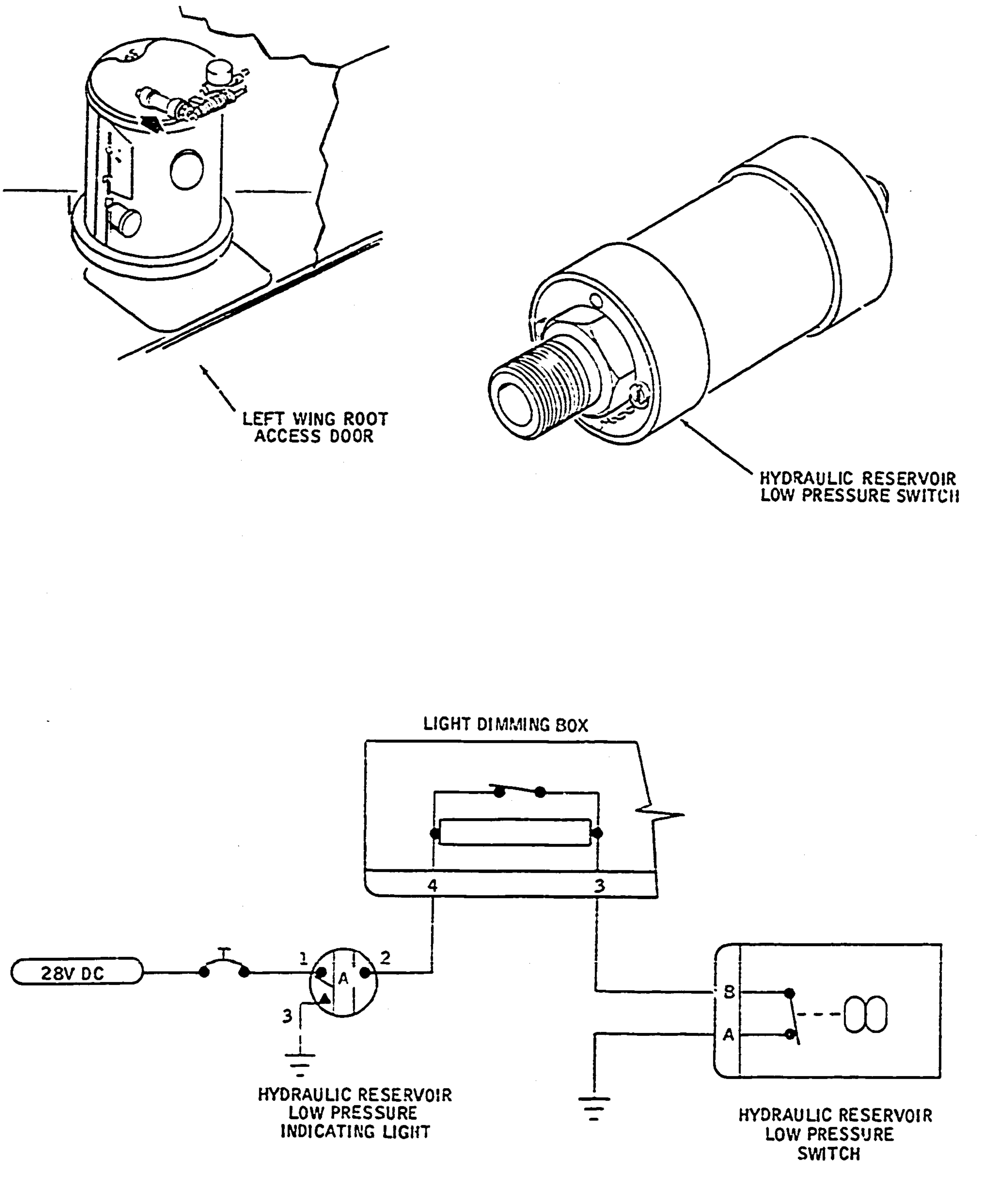


HA2-152

Hydraulic Fluid Temperature Indicating
System -- Schematic
Figure 2



Hydraulic Fluid Pressure Indicating
System -- Schematic
Figure 3



HA2-202

Hydraulic Reservoir Low-Pressure Indicating
Light System -- Schematic
Figure 4

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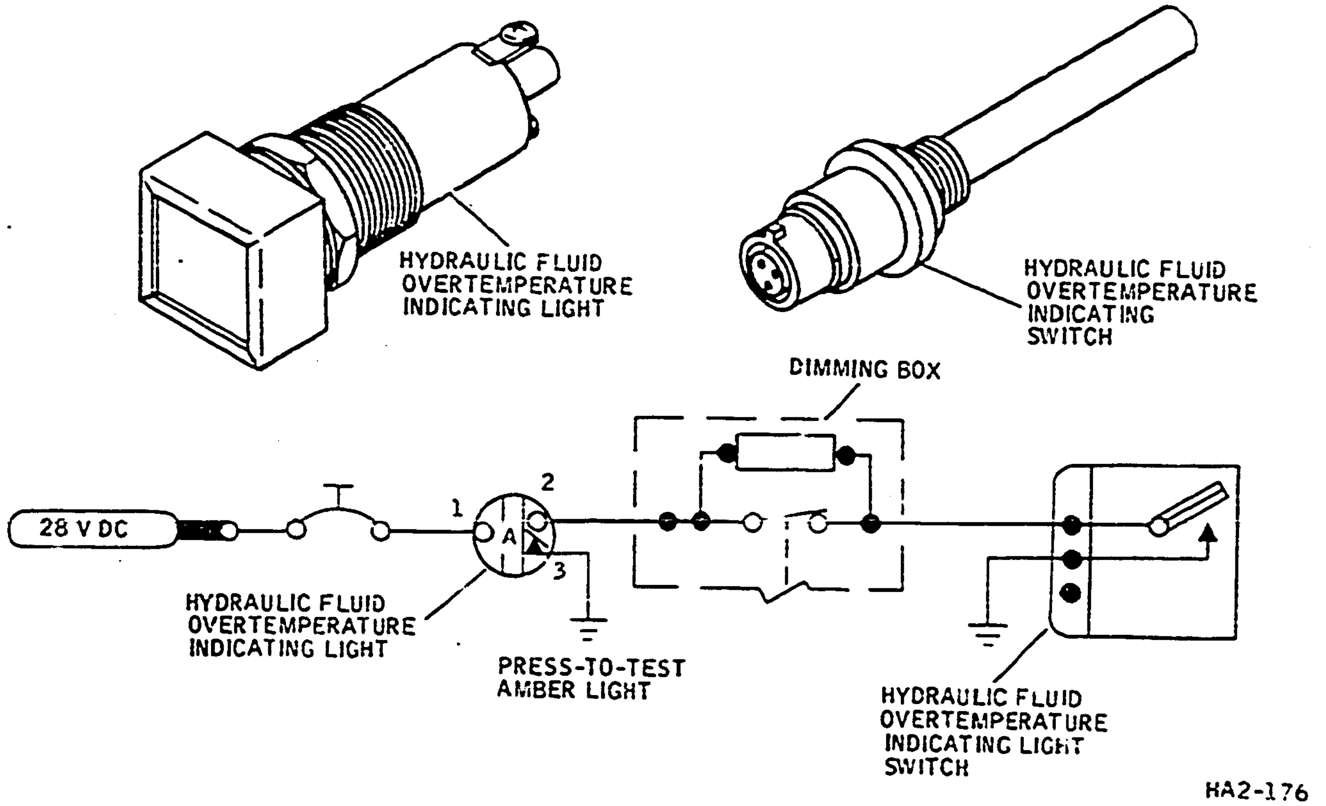
reservoir, a light-dimming switch and resistor, and a press-to-test amber indicator light in the flight compartment. The hydraulic reservoir low-pressure indicator light comes on when reservoir air pressure drops below 22 (±2) psi and goes off when the pressure reaches 27 (±2) psi.

6. Hydraulic Fluid Overtemperature Indicating Light System (See Figure 5.)

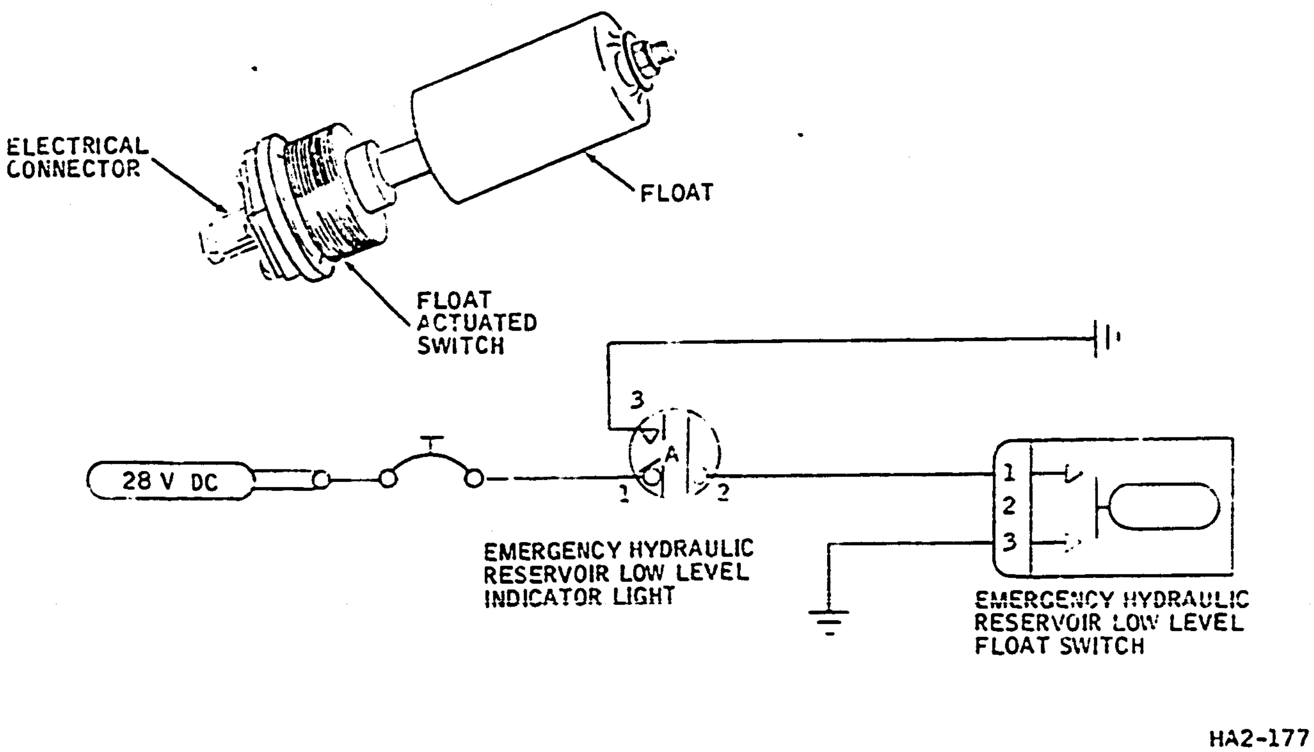
A. The hydraulic fluid overtemperature indicating light system provides a visual indication of overheated hydraulic fluid in the reservoir. The system consists of a dimmable, amber, press-to-test indicator light (see Chapter 31 for location), and a temperature-sensitive switch installed in the hydraulic reservoir. The placard on the cap of the indicator light reads hydraulic oil temperature. If the hydraulic fluid reaches an over-temperature condition, the temperature-sensitive switch will cause the indicator light to come on. The switch closes when the temperature reaches 71°C to 82°C (160°F to 180°F).



Hydraulic Fluid Overtemperature Indicating
Light System -- Schematic
Figure 5

7. Emergency Hydraulic Reservoir Low Level Indicating Light System (See Figure 6.)

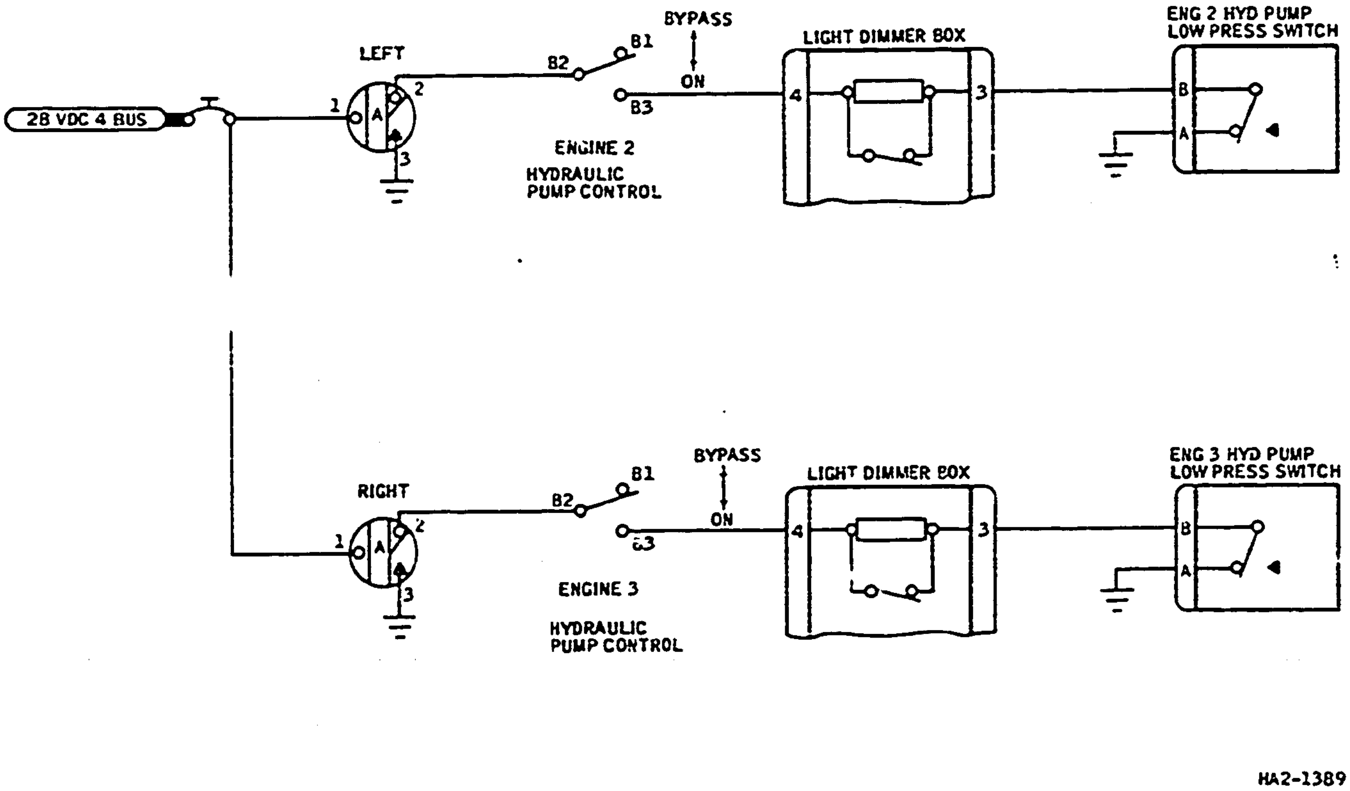
   A. The emergency hydraulic reservoir low level indicating light system provides a visual indication in the flight compartment if the fluid level in the auxiliary hydraulic pump alternate reservoir drops to approximately 0.8 US gallons (0.666 Imperial gallons, 3.15 liters). The system consists of a float-actuated, 2-position switch located on the alternate reservoir, an indicator light located in the flight compartment, and the wiring required to connect the system. When fluid level in the alternate reservoir drops below 0.8 US gallons, the float lowers, closing the switch, and the indicator light comes on. When the fluid level rises above 0.8 US gallons, the float rises, opening the switch, and the light goes out.



Emergency Hydraulic Reservoir Low Level
Indicating System -- Schematic
Figure 6

8. Engine-Driven Hydraulic Pump Low Pressure Indicating Light System (See Figure 7.)

A. The engine-driven hydraulic pump low-pressure indicating light system provides a visual indication of low-pressure at the output of either engine-driven pump. The system consists of two pressure-actuated switches, indicating light dimming boxes, and two press-to-test amber indicating lights. One switch is located at each engine-driven pump. The indicating lights are located in the flight compartment. When either of the engine-driven hydraulic pump bypass switches is in the on position, the corresponding engine-driven pump indicating light comes on if the output pressure of the corresponding pump drops below 1500 (±100) psig.



Engine-Driven Hydraulic Pump Low Pressure
Indicating Light System -- Schematic
Figure 7

INDICATING - TROUBLESHOOTING

1. Troubleshooting

Possible Causes	Isolation Procedure	Correction
A. HYDRAULIC FLUID QUANTITY INDICATOR NEEDLE STICKS		
(1) Friction: Dirt in indicator bearings Damaged jewels Damaged pivots	Check indicating system with indicator known to be good.	Replace faulty indicator.
B. HYDRAULIC FLUID QUANTITY INDICATOR DOES NOT OPERATE		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty transmitter	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
(3) Faulty hydraulic fluid quantity circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty inter-connecting wiring between indicator and transmitter	Check continuity of wiring.	Repair or replace faulty wiring.
C. HYDRAULIC FLUID TEMPERATURE INDICATOR IS INOPERATIVE		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty temperature bulb	Check indicating system with temperature bulb known to be good. Do not remove bulb from reservoir until proven faulty.	Replace faulty temperature bulb.

Possible Causes	Isolation Procedure	Correction
C. HYDRAULIC FLUID TEMPERATURE INDICATOR IS INOPERATIVE (Continued)		
(3) Faulty hydraulic oil temperature circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty inter-connecting wiring between indicator and temperature bulb	Check continuity of wiring.	Repair or replace faulty wiring.
D. HYDRAULIC FLUID TEMPERATURE INDICATOR IS ERRATIC		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty temperature bulb	Check indicating system with temperature bulb known to be good. Do not remove bulb from reservoir until proven faulty.	Replace faulty temperature bulb.
(3) Faulty inter-connecting wiring between indicator and resistance bulb	Check continuity of wiring.	Repair or replace faulty wiring.
E. HYDRAULIC FLUID PRESSURE INDICATOR IS INOPERATIVE (HYDRAULIC POWER ON)		
(1) Faulty indicator	Check indicating system with pressure indicator known to be good.	Replace faulty indicator.
(2) Faulty hydraulic fluid pressure transmitter	Check indicating system with pressure transmitter known to be good.	Replace faulty transmitter.

Possible Causes	Isolation Procedure	Correction
E. HYDRAULIC FLUID PRESSURE INDICATOR IS INOPERATIVE (HYDRAULIC POWER ON) (Continued)		
(3) Faulty hydraulic fluid pressure circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty interconnecting wiring between indicator and transmitter	Check continuity of wiring.	Repair or replace faulty wiring.
F. LOW READINGS GIVEN ON PRESSURE INDICATOR		
(1) Excessive leakage at transmitter inlet port	Check hydraulic pressure line connection at transmitter.	Tighten connections.
(2) Linkage between arbor and bourdon tube in transmitter too short	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
G. HIGH READINGS GIVEN ON PRESSURE INDICATOR		
(1) Linkage between arbor and bourdon tube in transmitter too long	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
H. RESERVOIR LOW-PRESSURE INDICATOR LIGHT IS INOPERATIVE		
(1) Defective bulb	Check bulb.	Replace defective bulb.

Possible Causes	Isolation Procedure	Correction
H. RESERVOIR LOW-PRESSURE INDICATOR LIGHT IS INOPERATIVE (Continued)		
(2) Faulty low-pressure switch on reservoir	Check low-pressure switch circuit using switch known to be good.	Replace defective switch.
(3) Faulty wiring in indicating light circuit	Check continuity of wiring.	Repair or replace faulty wiring.
I. HYDRAULIC FLUID OVERTEMPERATURE INDICATING LIGHT SYSTEM IS INOPERATIVE		
(1) Indicating light bulb burned out	Check light bulb by press-to-test.	Replace bulb.
(2) Faulty over-temperature switch	Check indicating circuit with overtemperature switch known to be good.	Replace faulty switch.
(3) Faulty hydraulic fluid overtemperature circuit breaker	Check circuit breaker for continuity.	Replace defective circuit breaker.
(4) Faulty inter-connecting wiring between overtemperature switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.
J. EMERGENCY FLUID LEVEL INDICATING LIGHT STAYS ON AT ALL TIMES		
(1) Low fluid level in alternate reservoir	Check fluid level in reservoir sight gage.	Fill reservoir (see 29-20-8). If reservoir does not fill when wing flaps are cycled, check for stoppage of wing flap return lines.

Possible Causes	Isolation Procedure	Correction
J. EMERGENCY FLUID LEVEL INDICATING LIGHT STAYS ON AT ALL TIMES (Continued)		
(2) Faulty float switch	Remove electrical connector from switch and check continuity between pins 1 and 3. Circuit should be open with reservoir full.	Replace faulty float switch.
(3) Faulty inter-connecting wiring between switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.
(4) Faulty press-to-test fixture light	Check light fixture for shorts or grounds.	Replace faulty fixture light.
K. EMERGENCY FLUID LEVEL LIGHT DOES NOT COME ON WHEN FLUID LEVEL IS BELOW 0.8 GALLON		
(1) Faulty light bulb	Check light bulb by press-to-test.	Replace faulty bulb.
(2) Faulty float switch	Remove electrical connector from switch, and check continuity between pins 1 and 3. Circuit should be closed with reservoir level below approximately 0.8 gallon.	Replace faulty float switch.
(3) Faulty inter-connecting wiring between float switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.
(4) Faulty press-to-test light fixture	Check light fixture for open circuit.	Replace faulty indicator light fixture.

INDICATING - TROUBLESHOOTING

1. Troubleshooting

Possible Causes	Isolation Procedure	Correction
A. HYDRAULIC FLUID QUANTITY INDICATOR NEEDLE STICKS		
(1) Friction: Dirt in indicator bearings Damaged jewels Damaged pivots	Check indicating system with indicator known to be good.	Replace faulty indicator.
B. HYDRAULIC FLUID QUANTITY INDICATOR DOES NOT OPERATE		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty transmitter	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
(3) Faulty hydraulic fluid quantity circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty inter-connecting wiring between indicator and transmitter	Check continuity of wiring.	Repair or replace faulty wiring.
C. HYDRAULIC FLUID TEMPERATURE INDICATOR IS INOPERATIVE		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty tempera-ture bulb	Check indicating system with temperature bulb known to be good. Do not remove bulb from reservoir until proven faulty.	Replace faulty temperature bulb.

Possible Causes	Isolation Procedure	Correction
C. HYDRAULIC FLUID TEMPERATURE INDICATOR IS INOPERATIVE (Continued)		
(3) Faulty hydraulic oil temperature circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty inter-connecting wiring between indicator and temperature bulb	Check continuity of wiring.	Repair or replace faulty wiring.
D. HYDRAULIC FLUID TEMPERATURE INDICATOR IS ERRATIC		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty tempera-ture bulb	Check indicating system with temperature bulb known to be good. Do not remove bulb from reservoir until proven faulty.	Replace faulty temperature bulb.
(3) Faulty inter-connecting wiring between indicator and resistance bulb	Check continuity of wiring.	Repair or replace faulty wiring.
E. HYDRAULIC FLUID PRESSURE INDICATOR IS INOPERATIVE (HYDRAULIC POWER ON)		
(1) Faulty indicator	Check indicating system with pressure indicator known to be good.	Replace faulty indicator.
(2) Faulty hydraulic fluid pressure transmitter	Check indicating system with pressure transmitter known to be good.	Replace faulty transmitter.
(3) Faulty hydraulic fluid pressure circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.

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Possible Causes	Isolation Procedure	Correction
E. HYDRAULIC FLUID PRESSURE INDICATOR IS INOPERATIVE (HYDRAULIC POWER ON) (Continued)		
(4) Faulty inter-connecting wiring between indicator and transmitter	Check continuity of wiring.	Repair or replace faulty wiring.
F. LOW READINGS GIVEN ON PRESSURE INDICATOR		
(1) Excessive leakage at transmitter inlet port	Check hydraulic pressure line connection at transmitter.	Tighten connections.
(2) Linkage between arbor and bourdon tube in trans-mitter too short	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
G. HIGH READINGS GIVEN ON PRESSURE INDICATOR		
(1) Linkage between arbor and bourdon tube in trans-mitter too long	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
H. RESERVOIR LOW-PRESSURE INDICATOR LIGHT IS INOPERATIVE		
(1) Defective bulb	Check bulb.	Replace defective bulb.
(2) Faulty low-pressure switch on reservoir	Check low-pressure switch circuit using switch known to be good.	Replace defective switch.
(3) Faulty wiring in indicating light circuit	Check continuity of wiring.	Repair or replace faulty wiring.

Possible Causes	Isolation Procedure	Correction
I. HYDRAULIC FLUID OVERTEMPERATURE INDICATING LIGHT SYSTEM IS INOPERATIVE		
(1) Indicating light bulb burned out	Check light bulb by press-to-test.	Replace bulb.
(2) Faulty over-temperature switch	Check indicating circuit with overtemperature switch known to be good.	Replace faulty switch.
(3) Faulty hydraulic fluid over-temperature circuit breaker	Check circuit breaker for continuity.	Replace defective circuit breaker.
(4) Faulty inter-connecting wiring between over-temperature switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.
J. EMERGENCY FLUID LEVEL INDICATING LIGHT STAYS ON AT ALL TIMES		
(1) Low fluid level in alternate reservoir	Check fluid level in reservoir sight gage.	Fill reservoir (see 29-20-8). If reservoir does not fill when wing flaps are cycled, check for stoppage of wing flap return lines.
(2) Faulty float switch	Remove electrical connector from switch and check continuity between pins 1 and 3. Circuit should be open with reservoir full.	Replace faulty float switch.
(3) Faulty inter-connecting wiring between switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.

Possible Causes	Isolation Procedure	Correction
J. EMERGENCY FLUID LEVEL INDICATING LIGHT STAYS ON AT ALL TIMES (Continued)		
(4) Faulty press-to-test fixture light	Check light fixture for shorts or grounds.	Replace faulty fixture light.
K. EMERGENCY FLUID LEVEL LIGHT DOES NOT COME ON WHEN FLUID LEVEL IS BELOW 0.8 GALLON		
(1) Faulty light bulb	Check light bulb by press-to-test.	Replace faulty bulb.
(2) Faulty float switch	Remove electrical connector from switch, and check continuity between pins 1 and 3. Circuit should be closed with reservoir level below approximately 0.8 gallon.	Replace faulty float switch.
(3) Faulty interconnecting wiring between float switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.
(4) Faulty press-to-test light fixture	Check light fixture for open circuit.	Replace faulty indicator light fixture.
L. ENGINE PUMP LOW-PRESSURE INDICATING LIGHTS INOPERATIVE		
(1) Defective bulb in indicating light	Check the bulb.	Replace defective light bulb.
(2) Engine pump bypass switch is in BYPASS position	Check position of bypass switch.	Place bypass switch in ON position.

Possible Causes	Isolation Procedure	Correction
L. ENGINE PUMP LOW-PRESSURE INDICATING LIGHTS INOPERATIVE (Continued)		
(3) Faulty low-pressure switch on engine pump	Check the indicating circuit using a switch known to be good.	Replace faulty switch.
(4) Faulty control switch	Check continuity through control switch.	Replace faulty control switch.
(5) Faulty wiring in indicating system	Check continuity of indicating system.	Repair or replace faulty wiring.

INDICATING - TROUBLESHOOTING

1. Troubleshooting

Possible Causes	Isolation Procedure	Correction
A. HYDRAULIC FLUID QUANTITY INDICATOR NEEDLE STICKS		
(1) Friction: Dirt in indicator bearings Damaged jewels Damaged pivots	Check indicating system with indicator known to be good.	Replace faulty indicator.
B. HYDRAULIC FLUID QUANTITY INDICATOR DOES NOT OPERATE		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty transmitter	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
(3) Faulty hydraulic fluid quantity circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty interconnecting wiring between indicator and transmitter	Check continuity of wiring.	Repair or replace faulty wiring.
C. HYDRAULIC FLUID TEMPERATURE INDICATOR IS INOPERATIVE		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.

Possible Causes	Isolation Procedure	Correction
C. HYDRAULIC FLUID TEMPERATURE INDICATOR IS INOPERATIVE (Continued)		
(2) Faulty temperature bulb	Check indicating system with temperature bulb known to be good. Do not remove bulb from reservoir until proven faulty.	Replace faulty temperature bulb.
(3) Faulty hydraulic oil temperature circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty interconnecting wiring between indicator and temperature bulb	Check continuity of wiring.	Repair or replace faulty wiring.
D. HYDRAULIC FLUID TEMPERATURE INDICATOR IS ERRATIC		
(1) Faulty indicator	Check indicating system with indicator known to be good.	Replace faulty indicator.
(2) Faulty temperature bulb	Check indicating system with temperature bulb known to be good. Do not remove bulb from reservoir until proven faulty.	Replace faulty temperature bulb.
(3) Faulty interconnecting wiring between indicator and resistance bulb	Check continuity of wiring.	Repair or replace faulty wiring.

Possible Causes	Isolation Procedure	Correction
E. HYDRAULIC FLUID PRESSURE INDICATOR IS INOPERATIVE (HYDRAULIC POWER ON)		
(1) Faulty indicator	Check indicating system with pressure indicator known to be good.	Replace faulty indicator.
(2) Faulty hydraulic fluid pressure transmitter	Check indicating system with pressure transmitter known to be good.	Replace faulty transmitter.
(3) Faulty hydraulic fluid pressure circuit breaker	Check circuit breaker for continuity.	Replace faulty circuit breaker.
(4) Faulty interconnecting wiring between indicator and transmitter	Check continuity of wiring.	Repair or replace faulty wiring.
F. LOW READINGS GIVEN ON PRESSURE INDICATOR		
(1) Excessive leakage at transmitter inlet port	Check hydraulic pressure line connection at transmitter.	Tighten connections.
(2) Linkage between arbor and bourdon tube in transmitter too short	Check indicating system with transmitter known to be good.	Replace faulty transmitter.

	Possible Causes	Isolation Procedure	Correction
G.	**HIGH READINGS GIVEN ON PRESSURE INDICATOR**		
(1)	Linkage between arbor and bourdon tube in transmitter too long	Check indicating system with transmitter known to be good.	Replace faulty transmitter.
H.	**HYDRAULIC FLUID OVERTEMPERATURE INDICATING LIGHT SYSTEM IS INOPERATIVE**		
(1)	Indicating light bulb burned out	Check light bulb by press-to-test.	Replace bulb.
(2)	Faulty overtemperature switch	Check indicating circuit with overtemperature switch known to be good.	Replace faulty switch.
(3)	Faulty hydraulic fluid overtemperature circuit breaker	Check circuit breaker for continuity.	Replace defective circuit breaker.
(4)	Faulty interconnecting wiring between overtemperature switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.
I.	**EMERGENCY FLUID LEVEL INDICATING LIGHT STAYS ON AT ALL TIMES**		
(1)	Low fluid level in alternate reservoir	Check fluid level in reservoir sight gage.	Fill reservoir (see 29-20-8). If reservoir does not fill when wing flaps are cycled, check for stoppage of wing flap return lines.

Possible Causes	Isolation Procedure	Correction
I. EMERGENCY FLUID LEVEL INDICATING LIGHT STAYS ON AT ALL TIMES (Continued)		
(2) Faulty float switch	Remove electrical connector from switch and check continuity between pins 1 and 3. Circuit should be open with reservoir full.	Replace faulty float switch.
(3) Faulty interconnecting wiring between switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.
(4) Faulty press-to-test fixture light	Check light fixture for shorts or grounds.	Replace faulty fixture light.
J. EMERGENCY FLUID LEVEL LIGHT DOES NOT COME ON WHEN FLUID LEVEL IS BELOW 0.8 GALLON		
(1) Faulty light bulb	Check light bulb by press-to-test.	Replace faulty bulb.
(2) Faulty float switch	Remove electrical connector from switch, and check continuity between pins 1 and 3. Circuit should be closed with reservoir level below approximately 0.8 gallon.	Replace faulty float switch.
(3) Faulty interconnecting wiring between float switch and indicating light	Check continuity of wiring.	Repair or replace faulty wiring.

Possible Causes	Isolation Procedure	Correction
J. EMERGENCY FLUID LEVEL LIGHT DOES NOT COME ON WHEN FLUID LEVEL IS BELOW 0.8 GALLON (Continued)		
(4) Faulty press-to-test light fixture	Check light fixture for open circuit.	Replace faulty indicator light fixture.

INDICATING - MAINTENANCE PRACTICES

1. General

A. Any time a major component (indicator or transmitter) is replaced, or quantity pressure or temperature indicating systems, is repaired, the affected system should be checked for operation and accuracy. Refer to paragraph 2, 3, or 4 for operational checks of the indicating systems.

2. Inspection/Check Hydraulic Fluid Quantity Indicating System

A. Check Hydraulic Fluid Quantity Indicating System

(1) Open auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of EPC circuit breaker panel.

(2) Depressurize hydraulic system (see 29-00).

(3) Relieve hydraulic reservoir air pressure (see 29-00).

(4) Drain hydraulic reservoir (see 29-00). Pointer on fluid quantity indicator in flight compartment should be at low end of indicator scale.

(5) Put 1 gallon (0.83 Imperial gallons, 3.79 liters) of hydraulic fluid into reservoir. Pointer on fluid quantity indicator should just begin to move.

NOTE: All measurements of fluid and positions of indicator are approximate due to a tolerance of ±5 percent allowed in system.

(6) Add an additional 4 gallons (3.33 Imperial gallons, 15.14 liters) of hydraulic fluid to reservoir. Indicator pointer should rise to just past auxiliary range on indicator dial.

(7) Add an additional 5 gallons (4.16 Imperial gallons, 18.93 liters) of hydraulic fluid to reservoir. Indicator pointer should rise to letter L in normal area of indicator dial.

(8) Fill reservoir to full condition as described on instruction placard on reservoir.

NOTE: Sight gage on the reservoir indicates full when approximately 12.9 US gallons (10.74 Imperial gallons, 48.84 liters) of hydraulic fluid are added.

(9) Open hydraulic oil temperature and quantity circuit breaker, located on miscellaneous section of EPC circuit breaker panel. Indicator pointer should go off scale at lower end.

(10) Close hydraulic oil temperature and quantity control circuit breakers and auxiliary hydraulic pump control circuit breaker.

3. <u>Inspection/Check Hydraulic Fluid Temperature Indicating System</u>

A. Check Hydraulic Fluid Temperature Indicating System

(1) Pressurize auxiliary hydraulic system (see 29-00).

<u>WARNING:</u> MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(2) Cycle wing flaps several times to circulate and warm hydraulic fluid.

<u>WARNING:</u> MAKE CERTAIN THAT WING FLAP AREA IS CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(3) Check hydraulic fluid temperature indicator in flight compartment for rise in temperature.

(4) Depressurize auxiliary hydraulic system (see 29-00).

4. <u>Inspection/Check Hydraulic Fluid Pressure Indicating System</u>

A. Check Hydraulic Fluid Pressure Indicating System

(1) Place hydraulic system selector control lever in general system (normal) position.

(2) Pressurize hydraulic system with hydraulic test stand (see 29-00).

<u>WARNING:</u> MAKE CERTAIN THAT LANDING GEAR CONTROL LEVER IS IN DOWN POSITION AND THAT LANDING GEAR GROUND LOCKPINS ARE INSTALLED.

(3) Check hydraulic fluid pressure indicator in flight compartment for 2800 to 3000 psi. Compare flight compartment indicator with indicator on test stand. Indicators should indicate same pressure ±5.0 percent.

(4) Depressurize hydraulic system (see 29-00).

(5) Pressure indicator should gradually decrease to zero psi.

HYDRAULIC FLUID QUANTITY TRANSMITTER - MAINTENANCE PRACTICES

1. General

   A. The hydraulic fluid quantity transmitter is located on the hydraulic system reservoir which is located aft of the wing rear spar in the left wing root.

   B. Access to the transmitter is through the left wing root access door.

2. Tools and Equipment Required

   A. Cement (EC-870, Minnesota Mining and Manufacturing Co., or equivalent) is used for sealing the fluid quantity transmitter gasket.

3. Removal/Installation Hydraulic Fluid Transmitter

   A. Remove Transmitter

      (1) Open following circuit breakers:

Circuit Breaker	Panel Section
Hydraulic temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

      WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Drain hydraulic reservoir (see 29-00, Maintenance Practices).

      (5) Disconnect electrical connector from hydraulic fluid quantity transmitter.

      (6) Remove hydraulic fluid quantity transmitter and gasket from transmitter mounting flange on reservoir.

      (7) Cover opening in reservoir.

B. Install Transmitter

(1) Make certain that the following circuit breakers are open:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

(2) Clean hydraulic fluid quantity transmitter mounting flanges on reservoir and transmitter.

(3) Using (EC-870) cement, cement a new gasket to mounting flange on reservoir.

(4) Spread cement on mounting flange of hydraulic fluid quantity transmitter.

(5) Install transmitter on reservoir. Safety mounting bolts with lockwire.

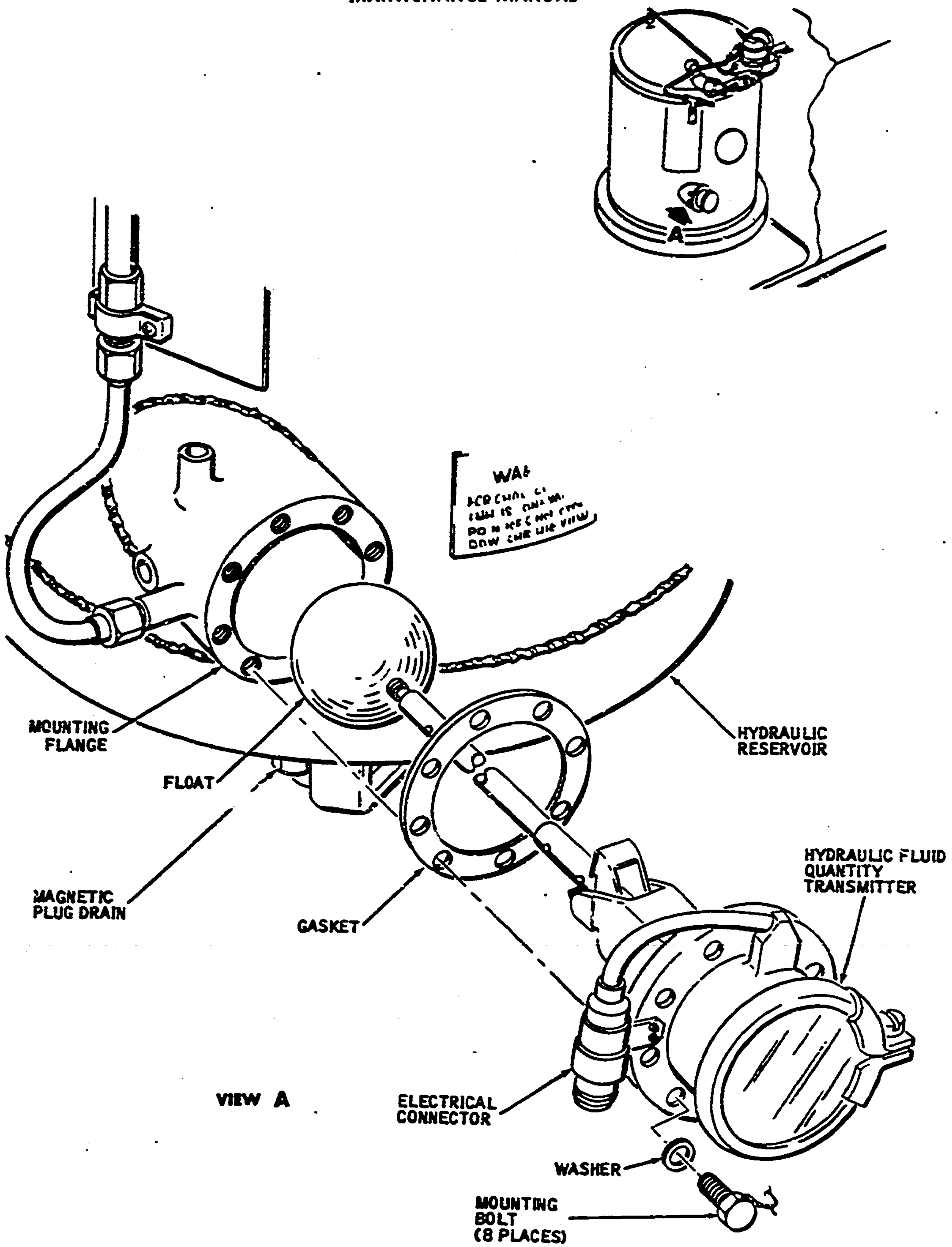
(6) Connect electrical connector to hydraulic fluid quantity transmitter.

(7) Fill reservoir as described on instruction placard on reservoir.

(8) Close following circuit breakers:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

(9) Pressurize hydraulic system reservoir (see 29-00, Maintenance Practices).



Hydraulic Reservoir Fluid Quantity
Transmitter -- Installation
Figure 201

4. Inspection/Check Hydraulic Fluid Quantity Transmitter

A. Check Transmitter

(1) Check operation of transmitter (see 29-30-0, Maintenance Practices).

(2) Check transmitter mounting for security of mounting, proper lockwire, and leaks.

(3) Check electrical connector and wiring for general condition and security.

HYDRAULIC FLUID TEMPERATURE BULB - MAINTENANCE PRACTICES

1. General

A. The hydraulic fluid temperature bulb is located on the side of the reservoir adapter, near the fluid quantity transmitter in the lower part of the hydraulic system reservoir which is located aft of the wing rear spar in the left wing root.

B. Access to the temperature bulb is through the left wing root access door.

2. Removal/Installation Hydraulic Fluid Temperature Bulb

A. Remove Temperature Bulb

(1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connector from bulb receptacle.

(6) Remove bulb from reservoir port. Discard O-ring.

B. Install Temperature Bulb

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

(2) Using new O-ring, install temperature bulb in reservoir port.

(3) Tighten bulb to torque of 20 (±2) inch-pounds.

(4) Connect electrical connector to receptacle on temperature bulb.

(5) Fill reservoir as described on instruction placard on reservoir.

(6) Close following circuit breakers:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

3. Inspection/Check Hydraulic Fluid Temperature Bulb

A. Check Temperature Bulb

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Check operation of temperature bulb (see 29-30-0, Maintenance Practices).

(3) Check bulb for security and leaks.

(4) Check electrical connector for security and general condition.

HYDRAULIC FLUID PRESSURE TRANSMITTER - MAINTENANCE PRACTICES

1. General

   A. The hydraulic fluid pressure transmitter is located in the nose gear well.

   B. Access to the pressure transmitter is through the nose gear well doors.

2. Removal/Installation Hydraulic Fluid Pressure Transmitter

   A. Remove Pressure Transmitter

      (1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Main and spoiler hydraulic system pressure indicator	Secondary instrument
Auxiliary hydraulic pump control	Cabin bus 4

WARNING: TAG AND SAFETY CIRCUIT BREAKER (SEE CHAPTER 20).

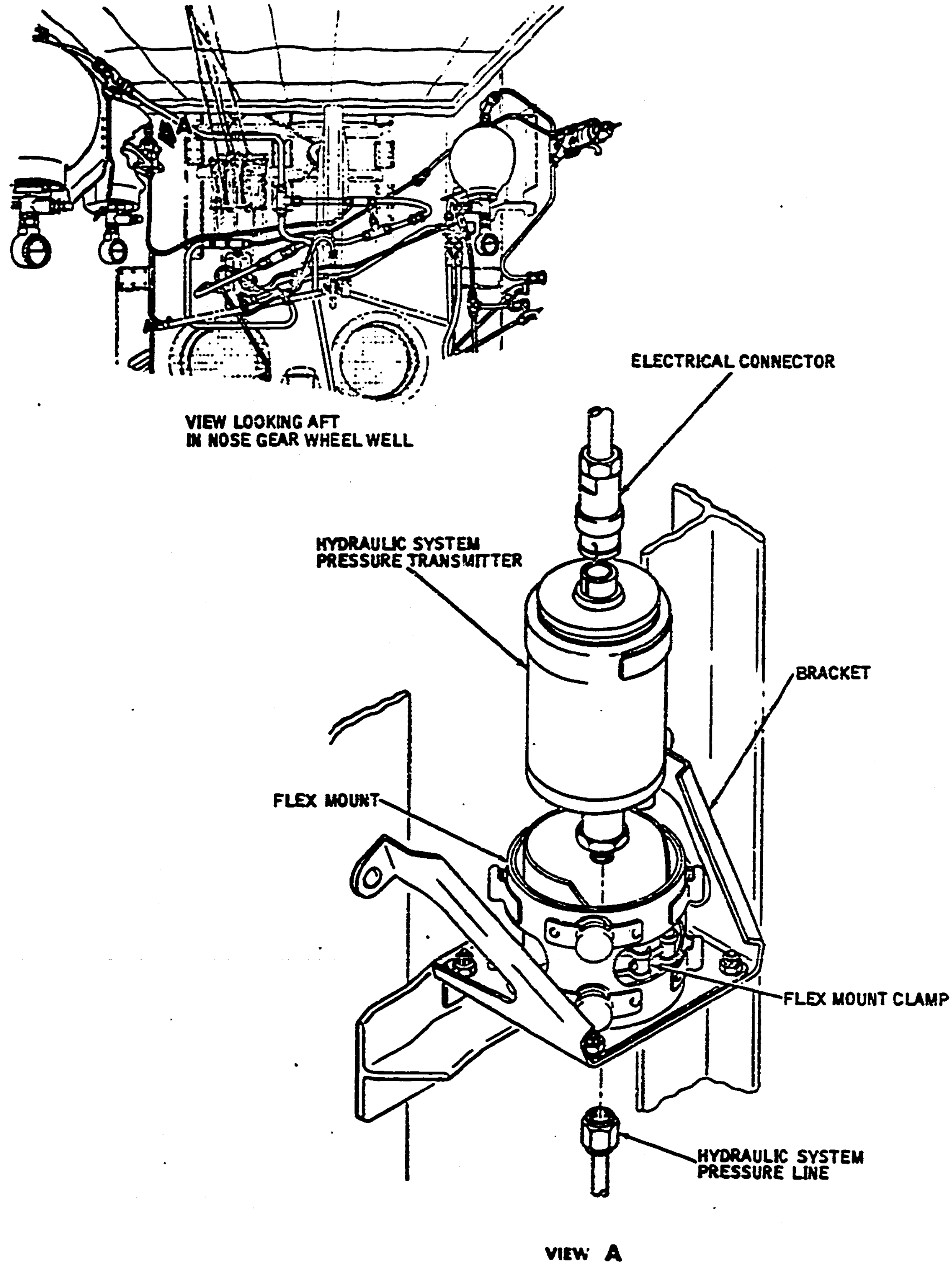
      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect electrical connector from hydraulic fluid pressure transmitter.

      (5) Disconnect hydraulic pressure line from snubber at inlet port of transmitter.

      (6) Loosen mounting clamp and remove transmitter.



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Hydraulic Fluid Pressure Transmitter -- Installation
Figure 201

B. Install Pressure Transmitter

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Main and spoiler hydraulic system pressure indicator	Secondary instrument
Auxiliary hydraulic pump control	Cabin bus 4

(2) Place transmitter in mounting clamp and position properly for pressure line to be connected to the transmitter without preloading the shockmount.

(3) Connect pressure line to inlet port snubber.

(4) Tighten mounting clamp and safety with lockwire.

(5) Connect electrical connector to receptacle on transmitter.

(6) Close following circuit breakers:

Circuit Breaker	Panel Section
Main and spoiler hydraulic system pressure indicator	Secondary instrument
Auxiliary hydraulic pump control	Cabin bus 4

3. Inspection/Check Hydraulic Fluid Pressure Transmitter

A. Check Pressure Transmitter

(1) Check operation of hydraulic fluid pressure transmitter (see 29-30-0, Maintenance Practices).

(2) Check hydraulic pressure line connection for security and leaks.

(3) Check electrical connector for security and general condition.

HYDRAULIC FLUID OVERTEMPERATURE INDICATING LIGHT SWITCH - MAINTENANCE PRACTICES

1. General

A. The hydraulic fluid overtemperature indicating light switch is installed in the hydraulic system reservoir adapter, just below the sight gage. The reservoir is located aft of the wing rear spar in the left wing root.

B. Access to the overtemperature indicating light switch is through the left wing root access door.

2. Removal/Installation Hydraulic Fluid Overtemperature Indicating Light Switch

A. Remove Overtemperature Indicating Light Switch

(1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

(2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(4) Drain hydraulic system reservoir (see 29-00, Maintenance Practices).

(5) Disconnect electrical connector from receptacle on overtemperature switch.

(6) Remove overtemperature switch from reservoir port. Discard O-ring.

B. Install Overtemperature Indicating Light Switch

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

(2) Using new O-ring, install hydraulic fluid overtemperature indicating light switch in reservoir.

(3) Tighten switch to torque of 20 (±2) inch-pounds. Safety with lockwire.

(4) Connect electrical connector to switch receptacle.

(5) Fill reservoir as described on instruction placard on reservoir.

(6) Close following circuit breakers:

Circuit Breaker	Panel Section
Hydraulic oil temperature and quantity	Miscellaneous
Auxiliary hydraulic pump control	Cabin bus 4

3. Inspection/Check Hydraulic Fluid Overtemperature Indicating Light Switch

A. Check Overtemperature Indicating Light Switch

(1) Pressurize hydraulic reservoir (see 29-00, Maintenance Practices).

(2) Check overtemperature switch for security and leaks.

(3) Check electrical connector for security and general condition.

EMERGENCY HYDRAULIC RESERVOIR LOW-LEVEL INDICATING LIGHT SWITCH - MAINTENANCE PRACTICES

1. General

   A. The emergency hydraulic reservoir low-level indicating light switch is installed in the auxiliary hydraulic pump alternate reservoir which is located in the left wing root area.

   B. Access to the low-level indicating light is through the left wing root access door.

2. Removal/Installation Emergency Hydraulic Reservoir Low-Level Indicating Light Switch

   A. Remove Switch

      (1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Hydraulic system overtemperature rudder and aileron manual indicator	Miscellaneous (dc bus)
Auxiliary hydraulic pump control	Cabin bus 4

      WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

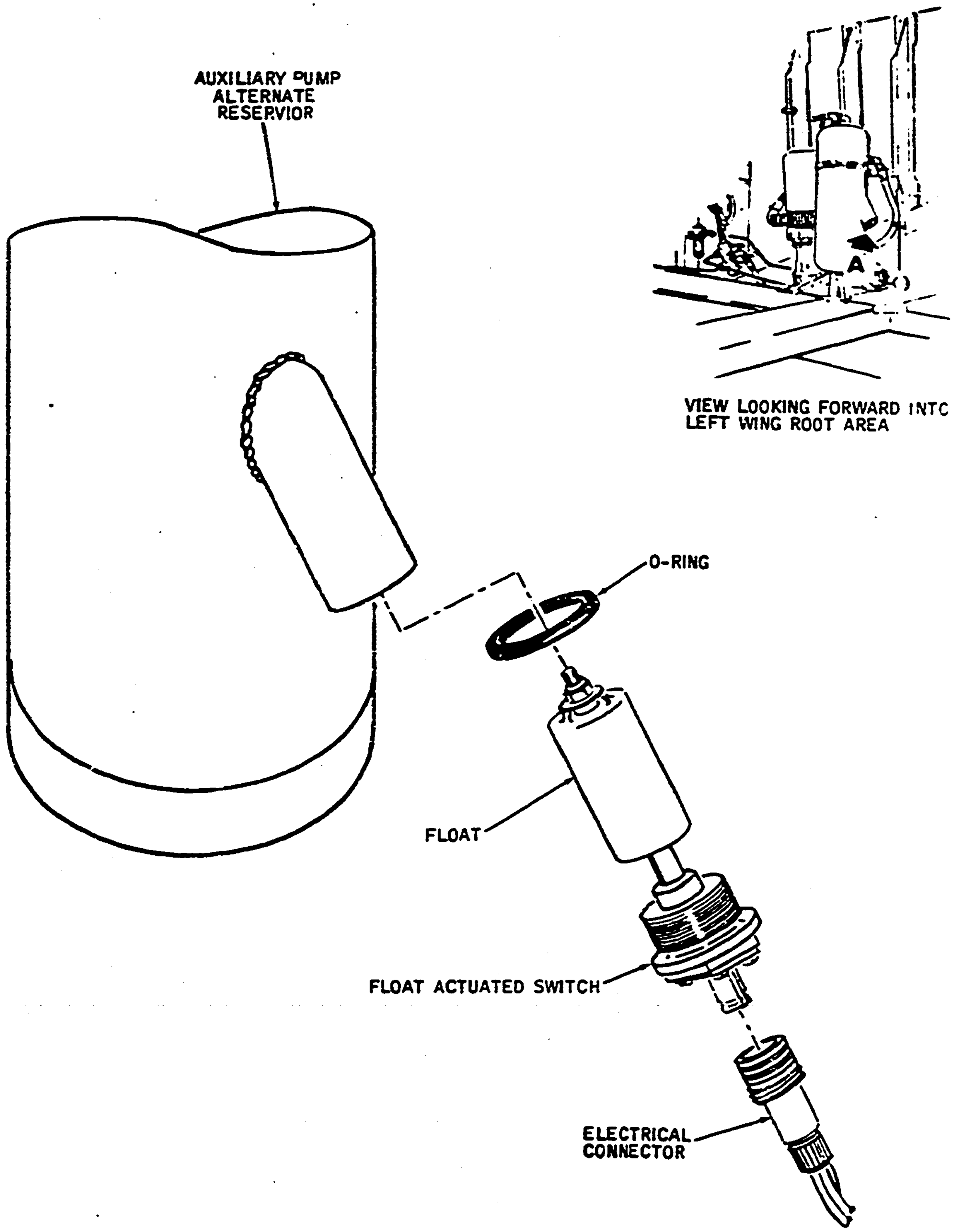
      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Place hydraulic system selector control lever in general system (normal) position.

      (5) Drain auxiliary hydraulic pump alternate reservoir (see 29-00, Maintenance Practices).

      (6) Disconnect electrical connector from emergency hydraulic reservoir low-level indicating light switch.

      (7) Remove switch from reservoir port. Discard O-ring.



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Emergency Hydraulic Reservoir Low-Level Indicating
Light Switch -- Installation
Figure 201

B. Install Switch

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Hydraulic system overtemperature rudder and aileron manual indicator	Miscellaneous (dc bus)
Auxiliary hydraulic pump control	Cabin bus 4

(2) Using new O-ring, install emergency hydraulic reservoir low-level indicating light switch in alternate reservoir port.

(3) Connect electrical connector to switch receptacle and safety with lockwire.

(4) Close following circuit breakers:

Circuit Breaker	Panel Section
Hydraulic system overtemperature rudder and aileron manual indicator	Miscellaneous (dc bus)
Auxiliary hydraulic pump control	Cabin bus 4

(5) Check that emergency hydraulic reservoir low-level indicator light is on.

(6) Pressurize hydraulic system (see 29-00, Maintenance Practices).

(7) Cycle wing flaps by placing wing flap handle in up and then in down position until hydraulic fluid can be seen in sight gage on alternate reservoir.

<u>WARNING</u>: MAKE CERTAIN THAT WING FLAP AREAS ARE CLEAR OF PERSONNEL AND OBSTRUCTIONS.

(8) Check that emergency hydraulic reservoir low-level indicator light is off when fluid if first observed in the sight gage.

(9) Depressurize hydraulic system (see 29-00, Maintenance Practices).

(10) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

(11) Fill hydraulic system reservoir as described on instruction placard on reservoir.

3. Inspection/Check Emergency Hydraulic Reservoir Low-Level Indicating Light Switch

A. Check Switch

(1) Check switch installation for leaks, general condition, and security of mounting.

(2) Check electrical connection for security of attachment and clearance in wire routing.

HYDRAULIC RESERVOIR LOW-PRESSURE INDICATING LIGHT SWITCH - MAINTENANCE PRACTICES

1. General

   A. The hydraulic reservoir low-pressure indicating light switch is mounted on the top of the hydraulic system reservoir, adjacent to the top of the sight gage. The reservoir is located aft of the wing rear spar in the left wing root.

   B. Access to the reservoir low-pressure switch is through the left wing root access door.

2. Removal/Installation Hydraulic Reservoir Low-Pressure Indicating Light Switch

   A. Remove Low-Pressure Switch

      (1) Open following circuit breakers located on EPC circuit breaker panel:

Circuit Breaker	Panel Section
Hydraulic system overtemperature rudder and aileron manual indicator	Miscellaneous (dc bus)
Auxiliary hydraulic pump control	Cabin bus 4

WARNING: TAG AND SAFETY CIRCUIT BREAKERS (SEE CHAPTER 20).

      (2) Depressurize hydraulic system (see 29-00, Maintenance Practices).

      (3) Relieve hydraulic reservoir air pressure (see 29-00, Maintenance Practices).

      (4) Disconnect electrical connector from reservoir low-pressure switch.

      (5) Remove low-pressure switch from reservoir port fitting. Discard O-ring.

B. Install Low-Pressure Switch

(1) Make certain that following circuit breakers are open:

Circuit Breaker	Panel Section
Hydraulic system overtemperature rudder and aileron manual indicator	Miscellaneous (dc bus)
Auxiliary hydraulic pump control	Cabin bus 4

(2) Using new O-ring, install low-pressure switch in reservoir port fitting.

(3) Connect electrical connector to low-pressure switch receptacle.

(4) Close hydraulic system overtemperature rudder and aileron manual indicator circuit breaker located on miscellaneous (dc bus) section of circuit breaker panel. Reservoir low-pressure indicator light in flight compartment should come on.

(5) Close auxiliary hydraulic pump control circuit breaker located on cabin bus 4 section of circuit breaker panel.

3. Inspection/Check Hydraulic Reservoir Low-Pressure Indicator Light Switch

A. Check Low-Pressure Switch

(1) Pressurize hydraulic system reservoir by the direct inflation method (see 29-00, Maintenance Practices). Reservoir low-pressure indicator light should go out as reservoir pressure reaches 30 psi.

(2) Check hydraulic reservoir low-pressure switch for air leaks at connection to reservoir.

(3) Check switch for security of attachment and general condition.

(4) Check electrical connector and wiring for security, general condition, and wire routing.

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